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Ice-making Machinery.

The failure of the ice crop during the past two winters in localities that heretofore have furnished an abundant supply, has had one good effect at least, that is, to teach the disappointed ones who are dependent upon natural ice for preservation of perishable produce, manufacturing purposes and domestic uses, the fact that there is a better way than trusting to fickle Nature; Science, ever stretching out her hand to assist our race, has already solved the problem, and, to the wonderment of those who have not kept up with the times in which we live, they find that ice—real ice—can be manufactured, and is being made by the hundreds of tons at a nominal cost; indeed, so low that it no longer pays to gather ice in the good old-fashioned way from "out of doors," and that, by means of mechanical refrigeration—as "sister art"—ice is losing ground, and need not be longer used for any purpose whatsoever in the arts, or for the preservation of perishable products as heretofore.

It is "An ill wind that blows nobody good," and in this particular instance, the failure to obtain a crop of ice, or its excessive cost when obtained from magnificent distances, has been the means of benefiting all concerned—those who adopt mechanical refrigeration and ice making, and the builders of the machinery therefor.

As the desire for knowledge on this special subject was never so great as at present, we describe and illustrate on pages 1, 2 and 3, the "Eclipse" ice-making and refrigerating machine built by Frick Company, engineers, Waynesboro, Pa.

Three views of a large single-acting refrigerating machine are given this week, to be followed by details in a later issue; for the description we are indebted to Mr. Edgar Penney, general superintendent of the Frick Works.

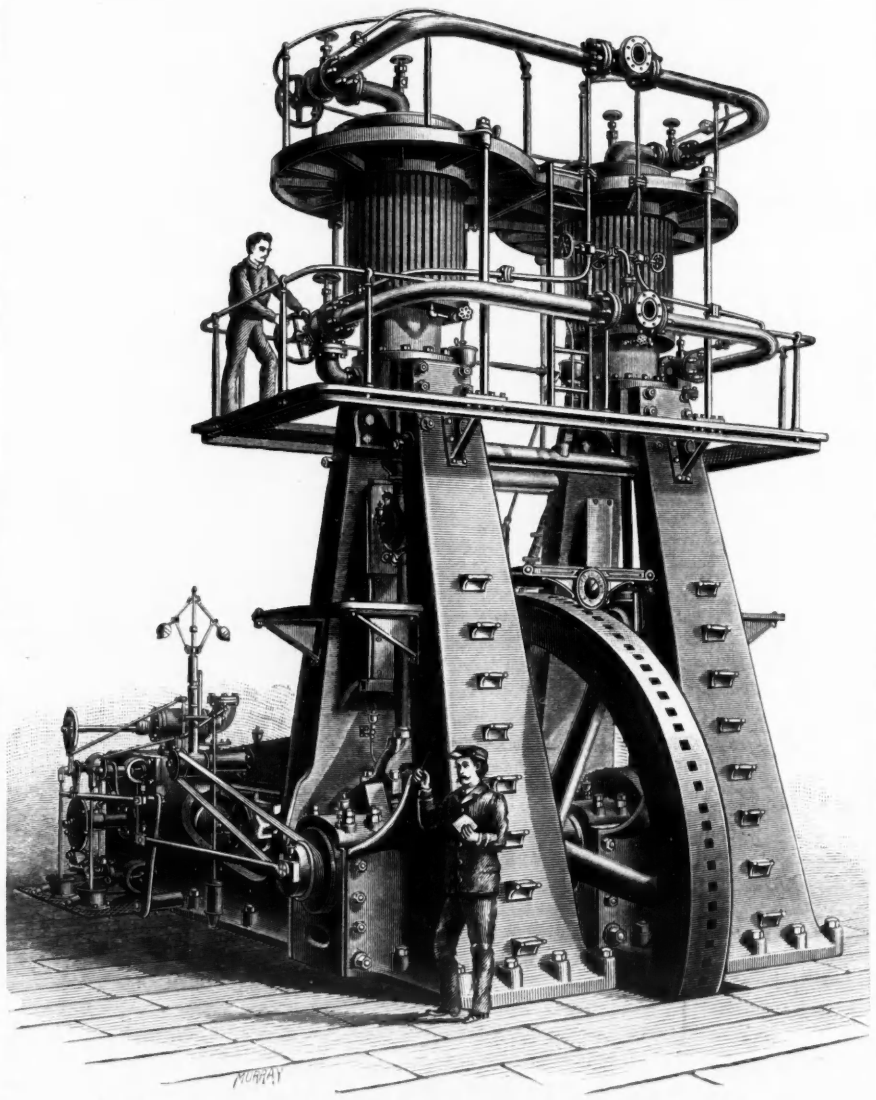
Fig. 1 is from a photograph of a 150-ton single-acting refrigerating machine, a perspective rear view. Fig. 2, the same machine, front view, and Fig. 3 a sectional side elevation; to these we refer the reader, and will briefly describe the construction of the machine proper.

Vertical, single-acting pumps are used, the motive power being a horizontal Corliss engine, the connecting rod of which plays through an opening in one of the columns, shown clearly in Fig. 3, and connected directly on main crank-pin of the pump, thus bringing that portion of the machine that needs the most attention convenient of access to the engineer, besides simplifying the construction and making a more compact arrangement and effective distribution of power during the maximum period of compression.

The design of the pump columns is shown in Figs. 1 and 3; they are tapering box girders, internally braced, the broad flange at the base of each being secured to foundation girders which are hidden in the masonry under the floor line.

A built-up system is most successfully employed, which will be understood from Fig. 3. All inside faces of the columns are in the same plane, and firmly bolted between the planed cheeks; at the upper and lower ends respectively are the pump bases and crank-shaft pillow blocks, which rigidly unite into one solid structure, and form the A frame. Attached to, and forming part of the compact structure, is the engine bed, composed of two members, the bed proper and the upper slide girder, the steam cylinder being of the overhanging type, with an outboard supporting foot.

The foundation sole plates and upper cross braces unite the two pairs of pump columns, the whole machine when completed being so well balanced, and the built-up system so successfully adapted, and so rigid, that, when testing machines under full steam in the works, it is found that it is self-contained, no precaution in the way of providing temporary foundations being necessary.



ONE HUNDRED AND FIFTY TON REFRIGERATING MACHINE.—FIG. 1.

The advantages of the built-up system may be briefly summarized as follows: Reducing the weight and bulk of large machine parts, that they may be moulded with ease and cast without risk; relieving all shrinkage strains; in case of defects, the loss in rejecting a defective part being comparatively small; bringing all parts within the compass of ordinary medium heavy tools; reducing the cost, facilitating machine shop manipulations; and in shipment, and in handling and erection of machinery in the premises, it is a peculiar advantage. Nothing is sacrificed in this example by adopting a built-up system, and a great deal is gained.

The fly-wheel is placed between the pumps in a central location, where it is most effective. One feature that is carried out in this machine is worthy of notice, and that is that all wearing parts are detachable and interchangeable, and in no instance are any of the standing or main parts of the structure subject to wear, hence they can be used for an indefinite period by removing the wearing faces and substituting new. This system is adopted as the best, and not because it is the cheapest, as the contrary is the case, and longer lifetime the result.

Convenient stairways and galleries are provided to facilitate reaching every part of the machine, and every part is get-at-able to a degree not generally found in machines of this class.

The ice-making and refrigerating machine we illustrate is the heaviest and largest ever made of which we have knowledge, and is very successful; the weight of the machine is 96½ tons. The details which we shall publish later will show the construction of some of the important parts.

The Missouri Railroad Commission has decided that it is not the legal thing to collect extra fare from passengers who fail to purchase tickets at the stations. This decision appears to be about right. If railway companies want to prevent passengers from entering their cars without the usual pasteboard, then they should put up the deterrent bars and gates.

The Modern Steam Plant and its Management.

BY PETER H. BULLOCK.

CONNECTING ROD BRASSES, DUST, AND PISTON CLEARANCE.

The above title is not an accident, but is so arranged on purpose, the same as a down-east landlord arranged his bill of fare, consisting of ginger-bread, grean peas and fish chowder. The former part is so placed, because the things spoken of are a very prominent part of an engine; the latter part is put in the rear, because less is seen of it, the dust in between, because there is where dust always gets, and they are used jointly because they bear a direct and indirect relation one to the other.

The term clearance, as used by me in this case, will not have the usual meaning, namely, the number of cubic inches of steam space between the piston head and the valves, when the engine is on the center, but will refer to the further distance the piston might go beyond its usual travel, before it struck anything. For instance, an engine may have a large steam clearance consisting of ports and uneven surfaces, but the piston may not be moved the $\frac{1}{64}$ of an inch before the follower bolts or some other protuberance of the piston will strike the head. It will be seen that while a large mechanical clearance involves also a large steam clearance, that the latter may exist to almost any unreasonable extent while the former may be entirely lacking.

As the connecting rod is the medium by which power is transmitted from the cross-head and changed from a reciprocating to a rotary motion at the crank, it follows that it must be of just the length between the cross-head at the end of its travel and the crank-pin when on the corresponding center. This proper length is of course originally determined by the builders, and it should not be altered by any subsequent adjustments. Let us see how this length is gradually changed unless the proper corrections are made from time to time. As generally constructed, the connecting rod consists of a shaft of iron with squared ends on which are fitted sliding straps adjustable by a driven key. Between the end of the rod and the bow part of the strap are placed the pin brasses. It is plain that the iron rod will not by any means change its length. The length of the whole rod, however, is measured from the center to the center of the brasses, and as these are subject to wear in both directions by the alternate pull and thrust of the piston, it follows that the tendency is to shorten the rod as this wear is taken up by the keys being driven.

The rapidity and amount of this shortening depends on several things, such as the quality of the wearing surfaces, the workmanship, the speed, the load, whether the parts are exposed to dust and dirt, the engine and pin being in line, and whether the engine is properly taken care of, which includes both adjusting and oiling.

First is the quality of the metal in contact, and little need be said on this subject, except that babbitt (?) metal can be bought at prices from 15 to 60 cents per pound. Second comes workmanship, and this includes smoothness of surfaces, whether the pin is round and set at right angles with the cross-

head or in line with the crank-shaft, as the case may be.

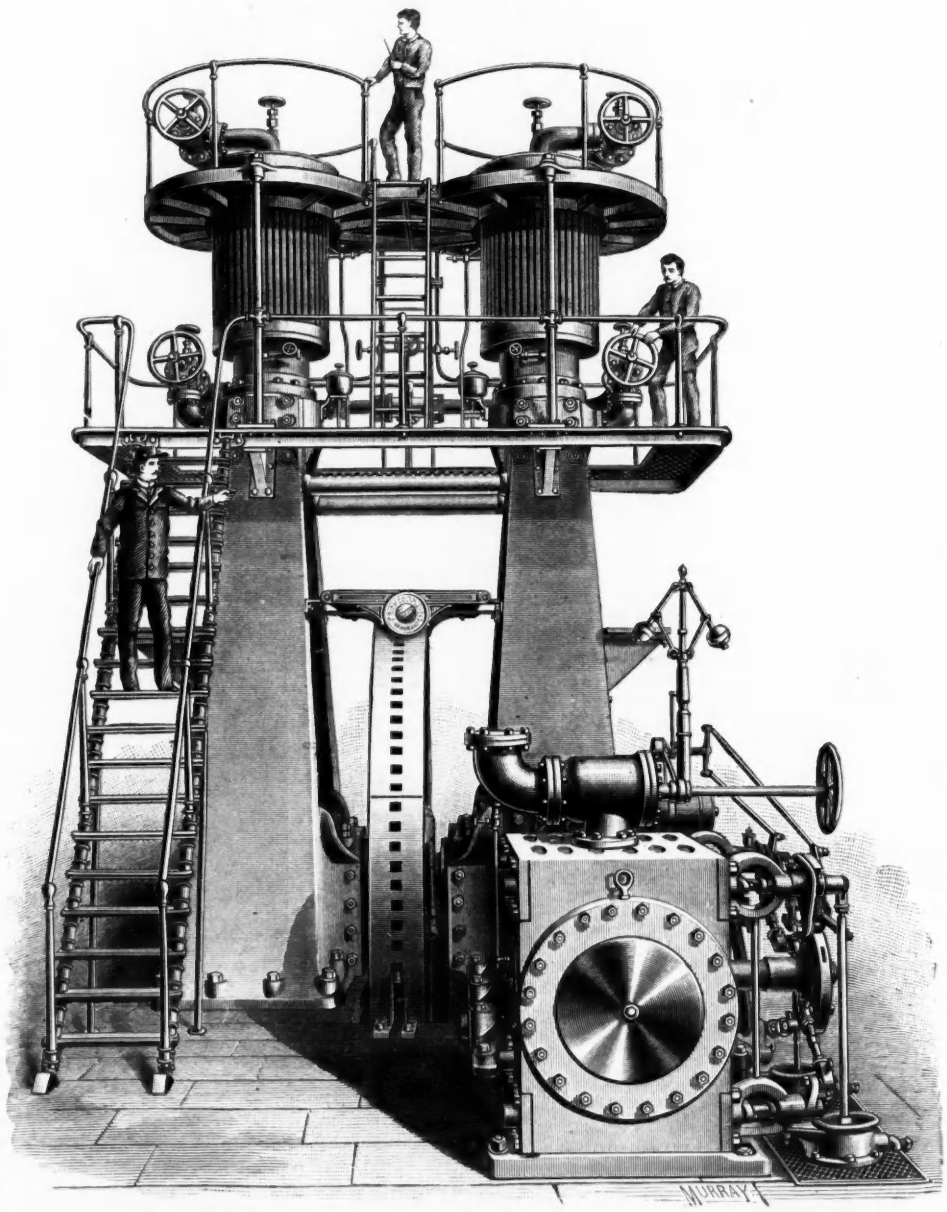
A crank-shaft may be at right angles with the center line of the cylinder, but if the pin is not in line with the shaft it will impart a continuous rolling motion to the brasses in the strap, and greatly increases the wear on them, as well as straining and loosening the gib and key in their slot through the strap and stub end. If the crosshead pin is not at right angles to the piston rod, the tendency is to twist the strap to the right or the left, as the case may be, and this induces wear on the ends of the brasses, and if there is any play they will jump from one end of the pin to the other, as the motion changes at each end of the stroke.

Third, the speed and the load are the next most important factors, as they refer to the distance a pin or a journal passes over its bearing surface in a given time, and the pressure under which it moves. Take for instance a crank-pin with 36 inches of exposed surface that revolves 60 times in a minute, and we have 2,160 time inches. Suppose that instead of 60 turns we have 250, then we find the time inches to be 9,000. This refers to speed. The crank may be impelled by a piston having 300 square inches area, and by a mean effective pressure of from 10 to 40 lbs., which would be a difference in the load of from 3,000 to 12,000 lbs., and it is quite possible to find similar engines running under the two extremes of conditions named.

The next condition referred to was one of dirt, which we are told is simply matter out of place, and certainly if it is out of place in being dirt at all, it is doubly so when in or about engine bearings; and here seems to be a good chance to have my say about dusty engine-rooms, and to suggest a remedy. There are numerous engine-rooms that are so located with reference to the shops, the street or the fire-room, as to make it impossible to prevent dust from finding its way in, unless some special means are provided to prevent it. In all engine-rooms, more or less heat is radiated (usually more), and this heat is always afforded ample opportunity for escape by open doors, windows, and sky-lights, and sometimes its exit is hastened by means of disk wheels or exhaust fans. Now, this seems to me to be wrong, both in theory and practice. In the first place, the pipes and other heated surfaces should be protected, so as to give off as little heat as possible; but of course there will always be some, and for comfort's sake that "some" is got rid of the easiest way possible, which is usually by opening the windows or sky-lights. Now every foot of heated air that goes out is replaced by another foot from somewhere else, it may be through cracks from the fire-room or shops, or through open doors from the street or yard, but wherever it comes from, it is liable to be loaded with a different but excellent grade of abrading and absorbing dust, which circulates about and on to every moving part of the engine, as you can see when the sun gets an inning for a few minutes in the morning. My suggestion is to reverse this order of things, and have a current of air going out of the engine room all the time through all the cracks and crannies instead of coming in, and this can be easily done by means of a fan or reversed disk wheel. The pipe or duct supplying this air should be brought from the roof or from some closed court where the wind does not have a chance to deposit dust. Experiments have shown me that a comparatively small amount of air forced into a room will find its way out in every direction, as the odor of evaporating oil of peppermint left in the room could be detected at every door and window crack or pipe opening. When all the above mentioned varieties of dust are stealing in, uninvited, do not install the worst enemy of all as a permanent resident.

Reference is made to whitewash, which, of all the abominable things for decorating an engine-room, takes the lead for cussedness. It has a pure, seductive look when fresh, but it absorbs mosture, collects dust, becomes thick and scaly, then peels off and falls on to the machinery at the slightest jar or provocation, and has about the same effect on a bearing as No. 60 emery and hot water. Don't get proud and whitewash your engine-room.

After all this dust we will return to the cause of brasses wearing out. The fourth trouble enumerated was the engine being out of line, and this may be a fault of the original setting up, or of improper adjustment or of the lack of any adjustment of any degree of depravity, but the result on the wear of the brasses will be none the less whatever the cause, and will be similar in effect as when the pin is not in line with the shaft. The crank-shaft may be at right angles with the center line of the cylinder, and the crank-pin in perfect line with the shaft, and still have the pin run badly out of line from the shaft being out of level. In fact, the shaft is quite as likely to get out of level as out of line horizontally, as the wear is more in a downward direction at the main than at the outboard bearing.



One Hundred and Fifty Ton Refrigerating Machine.—Fig. 2. See Page 1.

For the benefit of some young engineer, who may not have a level short or good enough to get onto any exposed place on his shaft, I will say that the engine may be correctly leveled with a plumb line, as it is only necessary to suspend the line in front of and so as to just touch the end of the crank-pin when on the bottom quarter, then turn the shaft until the crank is on the upper quarter, and if the line touches the pin just the same as at the bottom, the shaft is level.

This brings us to the fifth condition named, as to adjusting and oiling, which covers the practical things that an engineer should understand and attend to. It means the many little things that it is easy to do—if you know how—but hard to describe. It refers to that judgment that comes to every thinking man from his daily contact with practical affairs. It is that natural sense for the fitness of things that tells him when to let alone, and when to adjust anything he has the care of. It would be plain to an engineer of good judgment that he could not key up the pin of a locomotive as closely as he could that of a stationary engine that was firmly bolted to a solid foundation, although he might not ever have had any experience with a locomotive. An engineer of judgment has a great respect for small things, and knows that when he drives a key the width of a pencil mark, that it means something. He knows that there is a big difference between a push and a blow, and he takes care to avoid the latter on his crank-pin from there being too much looseness in the brasses. Now, about the blow a crank-pin gets when the brasses are worn. We will suppose that there is a 64th of an inch play, and that the moving parts which weigh a ton have just reached the inward center, and of course are under a thrust strain; then the valve opens, letting on steam for the return stroke. All the looseness is instantly taken up in the opposite direction and all the parts are under tension. Let us see what has happened. The pin has received the blow from the one-ton hammer impelled under a force of say 80 lbs. initial pressure on a piston of 300 square inches area, or 24,000 lbs. impact. In other words, a blow has been struck with a hammer weighing a ton and under a force of 12 tons, but the swing was fortunately very small, else the results would have been disastrous.

In practice there are a good many modifying features, such as lead and compression, by which the inertia of the moving parts is gradually taken up, and the shock made hardly noticeable. I also hope that none of my readers ever allow the 64th of an inch looseness in their pin brasses.

The lubrication of a crank-pin need no longer be a matter of speculation in any well-regulated engine-room, as there are oil cup devices that combine the desirable features of sight feed and positive conveyance of the oil to the joint desired, and any engineer who, by neglect, will allow his engine to run hot and dry, is not worthy of the title or of the position he holds.

The mechanical clearance of every engine should be known by the one having it in charge. It is a good plan to uncouple the connecting rod from the crosshead and push the latter to each end until the piston strikes the head, and then mark the guides at the ends of the crosshead. Then, when the engine is coupled up again and turned onto the centers, you can see just how much there is to spare, and how loose one of the follower bolts can get before it raps to be let out. In order to reduce the steam clearance, some builders recess holes in the cylinder head for the follower bolts. When this is done, care should be taken to get the head on just as it comes off, for if turned to any other position the holes and the bolt heads will fail to connect, and there will be trouble. It was said in the first part of this article that the tendency of wear was always to shorten the rod, which is true, if the straps are held by gib and key in the usual manner. If, however, the straps are bolted to the stub ends and the key is between the end of the rod and the brasses, the tendency of wear is to lengthen the rod from center to center; but if the key is outside of the brasses, wear will shorten the rod, the same as when a gib and key is used.

The Cincinnati Meeting of Mechanical Engineers.

The first paper at Wednesday's session was on "The Efficiency of Locomotives," by W. F. Dixon. The author concluded that the objections of wire-drawing and excessive compression at high-piston speeds, raised against the ordinary shifting valve gear, are frequently overdrawn, liberal proportions and the use of the Allen valve greatly mitigating the former, while inside clearance goes far toward remedying the latter. The clearance spaces in locomotive cylinders are usually too large, but as one valve controls all the events of the stroke, it is not advisable to reduce them below 7 or 8 per cent. of the piston displacement, to avoid compressing to initial pressure before the end of the stroke is reached. To overcome cylinder condensation and re-evaporation, steam jacketing, superheating and compounding have been tried. In spite of some economy that has resulted in a few instances, the author does not consider the first of these expedients warranted, as the cost of construction and maintenance would probably more than offset any benefit. The same applies to the second. The good results that have followed the introduction of the third, compounding, are usually attributed to reducing the range of temperature per cylinder. Although this is probably true of slow working engines, it is hard to see why it should be of fast working, as indicator cards from ordinary single expansion express engines show very slight evidence of cylinder condensation. If the high pressures which have almost always gone with compounding cannot be held accountable for resulting economy, it is likely that the solution may be found in the fact that compounding makes high degrees of expansion imperative.

The history of compound locomotives dates back to 1852, when two were built in England. The first American engine of this type was built by the Remingtons, at Ilion, New York, in 1870, for the Worcester & Shrewsbury Railroad Company. At the present time there are several hundred running in different parts of the world, mostly in Europe.

The higher the pressure is raised, the more efficient steam will be, but 200 lbs. gauge pressure per square inch is about as far as is desirable to go, on account of the high temperature. Recent experiments with high-class modern locomotive boilers gave evaporative rates, from and at 212° Fah. of 5.68 lbs. with anthracite, and 7.2 with bituminous coal. Anthracite is far less efficient as a fuel

than bituminous coal, and should only be used for special reasons.

In the discussion which followed the reading of this paper, Mr. W. E. Hall presented the following:

The subject which Mr. Dixon proposes for discussion is one to which too little attention has been given, and it is strange, but true: the most extensive information of an experimental nature concerning the efficient working of locomotives in the hands of the public is that written by D. K. Clark in his Railway Machinery, and which was published in 1854. It is a very large field to be covered, and information arising from experiments testing the many points which go to make up the efficiency of the machine, should, it is thought, go towards reducing the practice to a standard, as near as this can be done.

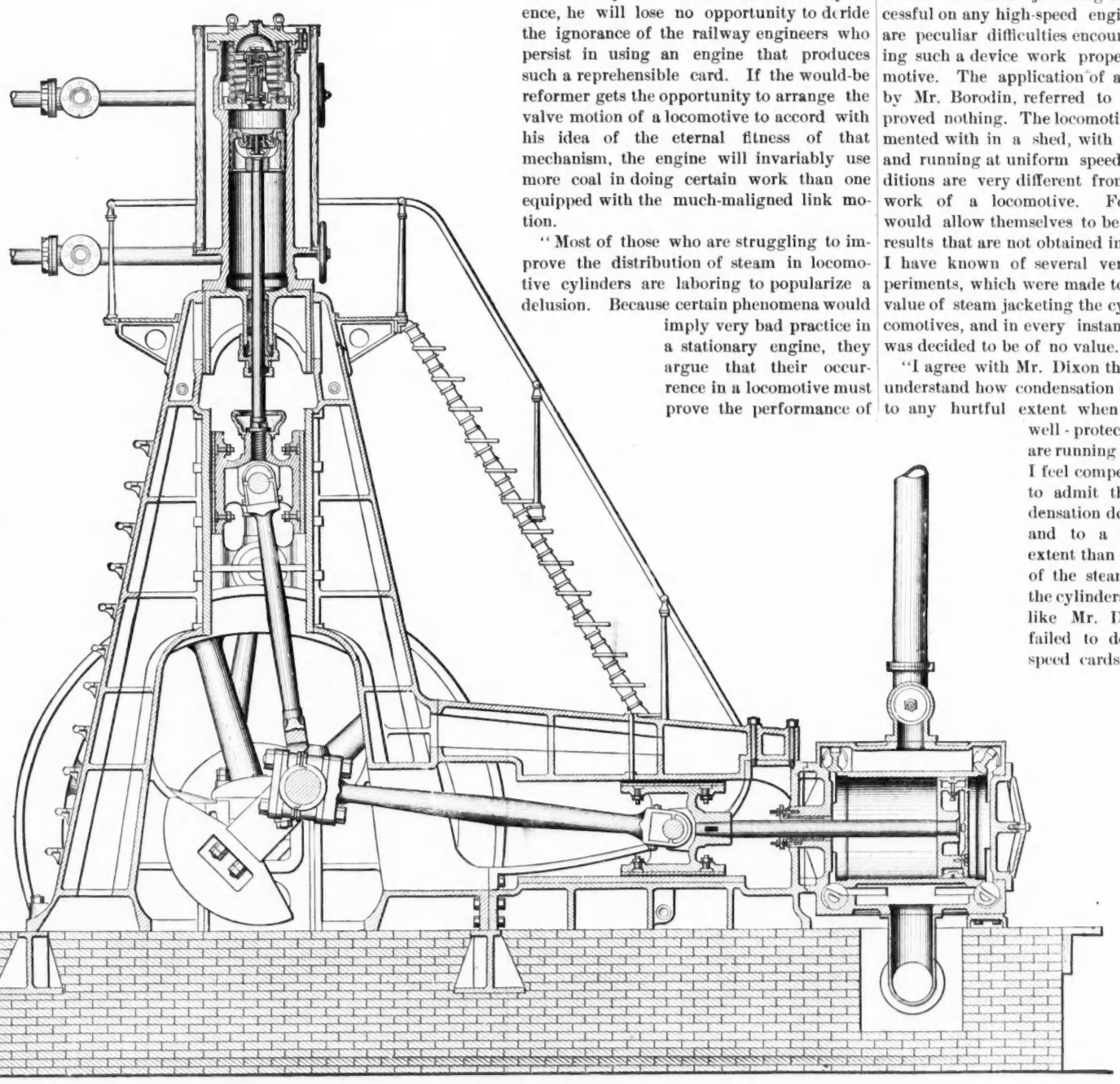
The compression question is dependent upon the character of the service, but, in handling it, care should be taken not to allow it to be too high, especially with engines that are to run at high speeds, where with the motion cut back it is apt to choke the engine, and increase the back pressure, and thereby interfere with the useful working of the engine. The percentage of clearance should also be considered in connection with the extent of surface which it exposes for condensation.

Two important elements which enter as economical factors in locomotive performance, and which it is desired to mention, are:

1st. Steam distribution and working.

2d. Combustion.

The distribution and working of the steam



ONE HUNDRED AND FIFTY TON REFRIGERATING MACHINE.—FIG. 3. SEE PAGE 1.

has been brought out prominently recently, in the trials and discussions of the application of compounding to locomotives, claiming thereby economy on the ground of a decrease in condensation arising from the less expansion of the steam in each of the two cylinders, although, when the high and low-pressure expansions of the compound are combined, a higher degree is obtained than with a single cylinder. It is simply a case of one and one make two, and the percentage of condensation is dependent, not upon the number of cylinders used in the expansion, but the degree to which the steam is expanded, together with that of the amount of surface of contact, from which increased radiation will result. That this is greater in compounding is self-evident, but that apparent economy is found in expanding in two or more cylinders instead of one, would go to show the loss which has heretofore been attributed to the much talked of "condensation and re-evaporation," has been over-estimated. This, too, in addition to the loss which must arise when intermediate receivers are used, whether these be in the form of an independent vessel, or so-called steam pipes leading from the high to low-pressure cylinder. Work cannot be obtained from steam without condensation, and it looks as though this had been confused, and a larger percentage of it attributed to condensation from radiation, and by the walls of the cylinder and passages, than properly belonged to it.

The point which Mr. Dixon makes of removing the degree of expansion from the control of the engine driver is the all-important one, and, no doubt, the true secret of the economy which it would appear has resulted from compounding.

Apparent economy is mentioned, because, as far as seen, all the trials of compound locomotives have had other influencing causes that would themselves produce a reduction in the coal consumption were they incorporated in the single cylinder engine. Special reference is made to the increased boiler pressure, which influences so much the economy of engine running. To determine the true efficiency of double against single expansion, the design of the boiler and the pressure carried, as well as all the other details of the construction, as near as could be, should be the same in both cases. No element of a machine can be tested in any other way.

As regards coal consumption, it is only necessary to call attention to the so-called extended smoke-boxes, now so generally used in locomotives, to convey some idea of the immense amount of rich combustible material which is collected there to be thrown away at a figure below the original cost of the coal. A reduction in its consumption, whether resulting in higher pressure, compounding, or the use of some form of the so-called vacuum exhaust pipes, or a combination of all three elements, is a question which the near future will develop, and we should not lose sight of the fact that improved combustion is as important a consideration as that of steam distribution and working.

Mr. Angus Sinclair, discussing this subject, said:

"The portion of Mr. Dixon's paper relating to cylinder compression in locomotives, deals with a subject about which considerable misapprehension exists. When an engineer first examines an indicator diagram taken from a locomotive running fast and cutting off short, he is almost invariably inspired with an ambition to distinguish himself by reforming the locomotive. If he is so placed that the aspirations of theory are unchilled by the demonstrations of experience, he will lose no opportunity to deride the ignorance of the railway engineers who persist in using an engine that produces such a reprehensible card. If the would-be reformer gets the opportunity to arrange the valve motion of a locomotive to accord with his idea of the eternal fitness of that mechanism, the engine will invariably use more coal in doing certain work than one equipped with the much-maligned link motion.

"Most of those who are struggling to improve the distribution of steam in locomotive cylinders are laboring to popularize a delusion. Because certain phenomena would imply very bad practice in a stationary engine, they argue that their occurrence in a locomotive must prove the performance of the engine to be defective. The cases are not parallel. The locomotive of to-day is a machine developed by a tentative process to meet the requirements of peculiarly severe and varying service. The proportions of cylinders and their passages do not vary materially among the locomotives of different railroads, or of different countries, and the proportions are undoubtedly those that produce the most satisfactory results in the performance of work. In no instance of general practice has it been found desirable to make the proportions of steam ports approximate to the sizes considered necessary with good stationary engines. When this important feature is so differently proportioned in the two kinds of engines, how can reasonable men expect that the distribution of steam will be nearly alike?

"The comparatively small ports, and the restricted opening at short points of cut-off, make a high compression line absolutely necessary to enable a locomotive to perform fairly heavy work at high speed. If the compression does not reach close to boiler pressure, the steam line will drop so suddenly that the engine can do very little work when the piston speed is close to 1,000 feet per minute. Increasing the size of the card by reducing the compression is a plausible theory, but in practice at very high speed it leaves the main rod to drag the piston away from the end of the cylinder.

"The men best able to judge as to what is required to make a locomotive work successfully have decided that high compression is necessary. In many instances, however, compression is carried to excess, even for the requirements of a high-speed locomotive. In such cases loss of efficiency and of economy result.

"I can scarcely agree with Mr. Dixon's views on steam jacketing. It is by no means certain that steam jacketing has proved successful on any high-speed engine, and there are peculiar difficulties encountered in making such a device work properly on a locomotive. The application of a steam jacket by Mr. Borodin, referred to in the paper, proved nothing. The locomotive was experimented with in a shed, with small power, and running at uniform speed. These conditions are very different from the ordinary work of a locomotive. Few engineers would allow themselves to be influenced by results that are not obtained in road service. I have known of several very careful experiments, which were made to ascertain the value of steam jacketing the cylinders of locomotives, and in every instance the jacket was decided to be of no value.

"I agree with Mr. Dixon that it is hard to understand how condensation can take place to any hurtful extent when engines with well-protected cylinders are running at high speeds. I feel compelled, however, to admit that such condensation does take place, and to a much greater extent than seven per cent. of the steam admitted to the cylinders, even though, like Mr. Dixon, I have failed to detect in high-speed cards any trace of condensation or re-evaporation. There is so much of what Hemenway calls 'initial expansion' in the cylinders of high-speed locomotives that it is impossible to judge how much of the drop is due to condensation or to wire-drawing. Nozzles and contracted steam passages exert so much influence on the exhaust end of the card that it is practically impossible to detect the signs of re-evaporation.

"Even though that view is taken by such a high authority as Sir Frederick Bramwell, I attach very little importance to the assertion that a vital element in making the compound locomotive a success is the tergiversation of the ignorant engine driver who refuses to work the steam expansively. If the compound locomotives prove successful enough to make that form of engine the railway motive power of the future, that consummation will be produced by the same causes which made marine and stationary compound engines popular with steam users, viz.: the capability of using the steam to greater advantage."

Mr. L. S. Randolph said:

"In regard to the efficiency of the locomotive, the question has been and is now not so much what is the efficiency of the locomotive, but what is her power? Not so much how many foot-pounds of energy it will develop per 100 pounds of combustible, but how many cars it will haul and make schedule time.

"It would seem from present information on this subject that the above view of the case is the correct one, for, within certain limits, the efficiency of the railroad as a machine for transportation is of more importance than the efficiency of the locomotive, and, in fact, the latter obtains its value only from its effect on the former.

"The tests of the efficiency of a locomotive, as usually made, are not only exceedingly difficult, but not very reliable. The varying factors of grades, curves and speed, together with the comparatively short time it is possible to give to the tests (not more than five or eight hours at the most), make it impossible to get the accuracy and reliability that the subject demands. Not until we take a leaf from marine engineering, and make, as it were, 'dock trials' of a locomotive, will we get the accuracy and reliability that we should.

"With the locomotive blocked up, a pillow block substituted for the driving-box, and a Prony brake to measure the power developed, we should be able to get with accuracy the efficiency of the locomotive under varying conditions of load, speed, etc., other conditions being kept uniform. Knowing these points accurately we could determine how much was gained or lost by overloading or underloading an engine, as well as the effect of varying dimensions."

Mr. Webber thought that the locomotive was a much maligned machine, and that, considering the circumstances under which it was required to work, the charge that it was wasteful and inefficient was unfounded, and that, on the contrary, it was a very efficient machine. He called attention to the fact that it had to do its work without such a foundation as is considered necessary for the engines with which its efficiency is compared, and works in dust and dirt of all kinds. He thought it would be a good idea to test the engineer and fireman more and the locomotive less, and also that builders should pay more attention to the reverse lever, and make it so that it could be more closely adjusted to the running conditions. The paper was further discussed by Messrs. Strong, Barnes, Wright, and Prof. Wood.

The paper by Mr. Willis E. Hall, Working of Railroads by Electricity, which we have published in a former issue, brought out an animated discussion. The first to take part being the president, Oberlin Smith, who said in substance that there was an engineering monster known as the electric locomotive. He thought that the idea of an electric locomotive should be entirely abandoned, so far as a heavy motor separate from the cars is concerned, and the power applied to each axle or a portion of the axles on each car, thereby much reducing the weight on bridges and other structures, as well as the track, and also the dead weight to be moved.

Mr. F. A. Scheffler gave some figures bearing on the comparative cost of building and operating electric and ordinary roads. Assuming that it would be necessary to have stations at not more than 30 miles apart, and each station would have to be equipped with engines, boilers, dynamos and other machinery for the development of 360 horse-power, he estimated the cost of each such station at a total of $37,000, the largest items in this estimate being $10,000 for engine, and $12,000 for the generating dynamo. This is without an auxiliary plant to be used in case of failure of the first, which would almost double the cost. For operating expenses of the station, including depreciation, interest, wages, etc., he estimated that $8,355 would be required per year, not including the cost of coal, which, assuming that the total power of the plant would be required one-half the time, and one-quarter the power the balance, would cost $8,322, at 3 lbs. per horse-power hour, and $3 per ton. This, added to the other operating expenses, would give for the total $16,677. The cost of the line working at a pressure of 2,000 volts, and carrying 112 amperes, would be $20,250, the interest on which would be, at 6 per cent., $1,215. In this estimate it is considered that copper wires would be required, equal to one square inch in diameter, and that two lines of this would be necessary, because with this voltage it would not be practicable to use the rails for the return circuit. This would make the weight of copper required for the 30 mile section, 476,784 lbs., which, at present prices, would cost $162,206, the interest on which would be $9,726. The necessary poles, cost of erection, etc., make up the amount given. Considering that the operating expenses of the motor and of a steam locomotive would be about the same, and making allowance for the difference in coal consumption, the difference in favor of the latter as compared with the cost of the electrical plant, would be $12,475 per year. The total cost of line and plant would be $219,356, which would buy about 20 new locomotives. Mr. Scheffler closed with the statement that, if steam transit would be permitted in our cities, the electric railroad business would not stand any kind of a chance for competition.

At the conclusion of the paper there was considerable applause, indicating that there was a considerable number of the members present who rather enjoyed such a presentation of the superiority of steam locomotion, and this applause was evidently in the minds of some of the members who discussed the question subsequently, one of them referring to the evident sentiment in favor of the steam locomotive, and another declaring that the members of the society could not afford to allow prejudice to influence them in this matter; that the electric railroad was bound to come with or without them, and it would be better that it should come with them. Several of the members took exceptions to some of the estimates of Mr. Scheffler, one of them declaring that, when the railroads went into the electric propulsion, they would not buy their motors at the present prices, but would build them at a cost of about $2,000, instead of paying $12,000—Mr. Scheffler's estimate of cost—and it was made evident that the electric motor had its friends among the members present. The prevailing opinion seemed to be that it would be to the advantage of all concerned if there could be a more general combination of good mechanical and good electrical engineering, and that much better electrical machinery generally would result from it.

The rain which prevented the drive that was to have taken place the afternoon of Wednesday, the 14th, gave the members, and especially the newspaper men, an opportunity of seeing that there might be such a thing as too much reading of papers and discussion in a single day. It is safe to say that hardly any one who attended all three sessions of the day, and paid close attention to the proceedings, regretted to see the day's work brought to a close. The presentation of eighteen papers, and their discussion, besides a business session, with its reports of committees, tellers of election, etc., proved to be about all that any one seemed to desire.

Thursday was entirely given up to pleasure by most of the members, and almost if not quite as much of it was crowded into the day and evening as there was of work in the preceding day. Six car-loads of members and their friends left the city at 9 o'clock for Hamilton, where they arrived about 10, and, taking possession of the Niles Tool Works, spent the balance of the forenoon in looking about and inspecting the many interesting things to be found there. Those who had not seen the works recently were of course much surprised at the proportions to which the plant had grown, employing as it now does nearly 1,000 men. It is evident that the buildings, extensive as they are, are considerably crowded, and the plans are completed for further enlargements, when the works will comprise a lathe-room 46x400 feet, a lathe and planer-room the same size, four erecting floors each 400 feet long and 50, 42, 37 and 36 feet wide; foundry floors 120x45, 120x42, 300x35, and 225x60 feet. This includes the ground floors only, a good portion of the buildings being two stories in height, and accommodating the lighter machine work, pattern shops, drafting-rooms, etc.

Some very heavy tools were noticed on the floor in process of construction, among others a planer and a slotting machine for the Midvale Steel Works, the former weighing about 120 tons, the latter 70 with 48" stroke. The planer will handle work eight feet high and wide, and among the other notable features has the platen gibbed to the bed, the weight resting upon very broad flat surfaces, and the platen being guided by dovetailed slides provided on one side with an adjustable gib—simply a reproduction on a mammoth scale of the cross-feed slide found on engine lathes. In both the flat and the angular surfaces brass rolls are provided, which run in oil wells, and, coming in contact with the sliding surfaces of the platen, provide for thorough lubrication. It is noticeable that the practice of the Niles Works sustains Mr. Dwight Slates' opinion on the value of cast-iron journals running in cast-iron boxes, mentioned some time ago in our columns, many of the spindles in their heaviest tools being made of cast-iron lapped and scraped to a fit. This has now been the practice there for a sufficient length of time to give ample evidence that it is entirely satisfactory.

Most of those interested in mechanical matters probably felt that two hours were scarcely sufficient for the inspection of such a plant, but the afternoon had been assigned for a different purpose, and so, promptly at noon, the visitors were called together by the music of a band, and by the whistling of the locomotive of the train which was to take them to a beautiful island about four miles distant, where were provided, by the courtesy of the Niles Works, all things necessary to a thorough enjoyment of the occasion, including a most bountiful and elegant lunch served in a pavilion open to the air, which was tempered to precisely the right degree. An orchestra furnished an appropriate accompaniment to the gastronomic operations, which, when completed, were followed by the usual speech-making, by Mr. Alexander Gordon, president of the Niles Tool Works, President Smith and Mr. Woodbury. Dancing, rowing and social intercourse filled up the rest of the time until long after the hour announced for the return to the city. On the way back a stop was made at Ivorydale long enough to inspect the works of Proctor & Gamble, which is claimed to be the largest and finest plant devoted to the making of soap in the world. The members, of course, saw much to interest them here, and enough soap to run several hotly contested political campaigns.

The much-talked-of Strong engine was used to draw this train, and, of course, was an object of considerable interest to many of the excursionists, especially those interested in railroad operating or locomotive building, by most of whom she was critically examined at some time during the trip.

The reception at the Art Museum in the evening was, of course, a very elegant and thoroughly enjoyable affair, being declared by the Cincinnati papers to have been one of the greatest social successes ever held there. Cincinnati's most prominent citizens were fully represented, and there was a most flattering address of welcome by Mr. A. T. Goshorn, which was responded to by Mr. Woodbury.

The drive about the city, which was to have taken place Wednesday afternoon, but was postponed on account of the rain to Friday afternoon, proved a very pleasant affair, and was participated in by almost the entire party. They first took the cars at the Little Miami station, and were taken out over the Louisville & Nashville bridge across the Ohio to the Chesapeake & Ohio Railroad, and, passing through Newport and Covington, recrossed the river by the great C. & O. bridge to the city, where they landed at a different station, and, taking carriages, proceeded on a tour of the suburbs and hill-tops which surround the city and form one of its most attractive features.

Those of the members who could arrange to do so staid over in the city in order to visit the Addystone Pipe Works, where they saw what is probably the largest and most complete plant for the production of cast-iron pipe in existence. A special invitation was sent in by the proprietors to visit the works, and a train was placed at their disposal for the purpose, an elegant lunch being provided at the works.

While it is generally recognized that it would be a difficult matter to so modify or enforce the rules limiting the time allowed for the presentation of papers and for their discussion, the opinion seemed quite general that some improvement in their practical working would be very desirable if it could be effected. Not every one has acquired the valuable faculty of putting his ideas in the fewest possible words, nor of sticking closely to the subject under discussion. A good many ideas can be expressed in five minutes' time by one thoroughly conversant with the subject upon which he talks, and while there are many occasions when it is felt that more time can very profitably be given, it would probably be better, upon the whole, if the rule were strictly enforced, giving all who desire an opportunity to talk, and then allowing unfinished discussions to be resumed at the end of the session, should time remain after the programme is gone through with. And the practice of one member who has not spoken, and probably does not intend to speak on the subject, giving up what he is pleased to call his time to the member on the floor in order that he may go on, is only begging the question, and while it is of advantage occasionally it probably works disadvantageously upon the whole.

There was a very general feeling of regret that Secretary Hutton was prevented from attending by sickness in his family, but fortune favored the society so far as the selection of a substitute was concerned, and no resolution of thanks came nearer expressing the sentiments of the members than that which was called out by the efficient manner in which Mr. Woodbury, at short notice, and with little or no preparation, discharged the difficult duties of the position.

The trip of the Eastern members over the Pennsylvania Railroad, in the special train of vestibuled cars, was a thoroughly enjoyable one, and it was regretted that not enough of them could go back at one time to secure the same accommodations on the return trip, though all were, of course, made comfortable.

Though not yet definitely determined, it seems very probable that the next meeting will be held at Richmond, Va. An invitation was received to meet there, and the general sentiment of the members seemed to be decidedly in favor of its acceptance.

A subscriber to the *Telephone Exchange* asked to be placed in communication with his medical man. Subscriber—"My wife complains of a severe pain at the back of her neck, and occasional nausea." Doctor—"She must have malaria." Subscriber—"What's best to be done?" At this moment the clerk at the central station alters the switch by mistake, and the unlucky husband receives the reply of a mechanical engineer in answer to inquiries of a mill owner. Engineer—"I believe the inside is lined with excoriations to a considerable thickness. Let her cool during the night, and in the morning, before firing up, take a hammer and pound her vigorously. Then get a garden hose with strong pressure from the main and let it play freely on the part affected." To his great surprise the doctor never saw his client again.—*Electric Age.*

There are 254 registered trade unions in England and Wales, with a membership of about 350,000.

Horizontal Boring Machine.

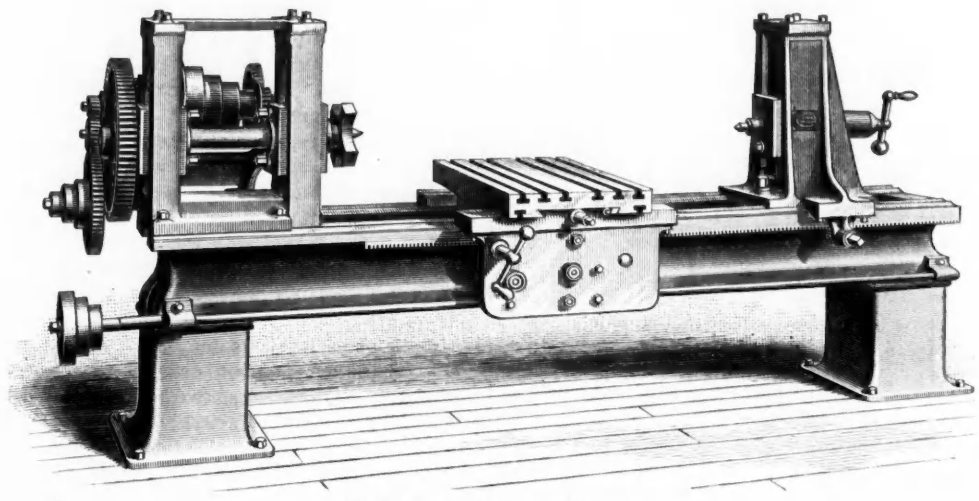
On this page we give an illustration of a boring machine recently brought out by Nicholson & Waterman, Providence, R. I.

So far as its principle of operation is concerned, it is the same as the lathe, and may be used with any kind of boring bar that may be preferred, either with a fixed cutter or with a sliding head, one advantage of the former being that it remains always at the same distance from the points of support, and the deflection of the bar therefore remains more nearly constant during the boring. The advantages of the machine over the lathe for such work are that the spindles are adjustable vertically together, thus avoiding the necessity for "blocking up" on the carriage, and at the same time securing the greatest possible rigidity for the particular job in hand; and an adjustable platen on the carriage, by which the work may be moved forward or back relative to the bar after being fastened to the platen.

Thus work can be secured in place with the necessity only for getting the central line of the bore in line with the travel of the carriage, the lateral and vertical adjustments needed being made afterwards.

Motion is imparted to the carriage in the same manner as in the ordinary engine lathe, provision being made for keeping the gears in proper relation to each other when the spindles are moved up or down. This vertical movement of the spindles takes place simultaneously, an adjustment being provided for correcting any error which may arise from wear, and restoring them to accurate alignment. The spindle is triple-geared, and all adjustable or movable parts of the machine can be securely clamped in place after adjustments are made.

For boring small cylinders, pillow blocks, frames of machines, etc., the machine will be found valuable.



HORIZONTAL BORING MACHINE.

Heating Furnaces.

BY D. K. NICHOLSON, STEELTON, PA.

(A Paper Presented at the Cincinnati Meeting of Mechanical Engineers.)

A Siemens furnace will probably call for less repairs than any other kind of a reverberatory furnace. The gas and air, coming up separate ports, do not unite until they have reached the hearth, where they come in contact with the metal to be heated. By the time the flame reaches the outgoing ports, it is pretty well spent, and does very little more injury to the brickwork than the incoming gas and air. The bricks are not subjected to the cutting action of flames as they are in a coal furnace.

The heated regenerators give the gas and air an upward tendency. This makes an outward pressure when the chimney damper is partially closed. It is necessary to work the furnace with an outward pressure when it is charged, close up to the door, to fill the furnace with flame and keep the cold air from drawing in at the doors, or when the charge on the hearth of the furnace is up to the required heat, and the drawing of it is delayed for a short time.

In the Smith furnace the regenerators are built in the ends of the furnace. The checkers are entirely open at the top, and on a level with the bridge of the furnace, which is at the same time one wall of the gas chamber. This furnace is generally used for quick heating. Its advantages are: the cheapness, the ease with which the checkers can be taken out and cleaned, and the bottoms of the gas and air conduits and the checker chambers are so little below the surface that they are not likely to become choked by water in low ground. Possibly the gas will not come in the furnace with as much pressure as in an ordinary Siemens furnace, unless the gas pipe from the top of the gas-producer stack is correspondingly higher. Gas is purer when it has a long way to travel from the producer to the furnace, the soot has a chance to deposit on its way, but the expansion and contraction of a long overhead tube must also be considered and provided for. The gas checkers often become clogged with this soot. The best way of cleaning them is through spontaneous combustion, which is brought about by shutting off the gas entirely from the furnace, placing the reversing valves on the center, and opening the stack damper, and at the same time a door of the furnace. There will then be a free passage of air from both ends of the hearth down through the checkers. A small amount of reddish matter will be left as a product of the combustion. When a gas, made of vaporized oil and steam, is used as the fuel, it comes into the checkers with such force that it will find its way through a choked mass of checker-work, when coal gas, with its gentle pressure, will not.

The hearth of a furnace is not of equal temperature over all its surface. There are different reasons for this: the design of the bridge, the arch in the roof tending to draw the bulk of the fire through the middle of the furnace, and the cold air at the doors chills off the front. If the piece of metal reaches all the way across the furnace, and the gas and air enter side by side or mix before coming over the bridge, there is very little difficulty in putting an even heat on the piece from end to end.

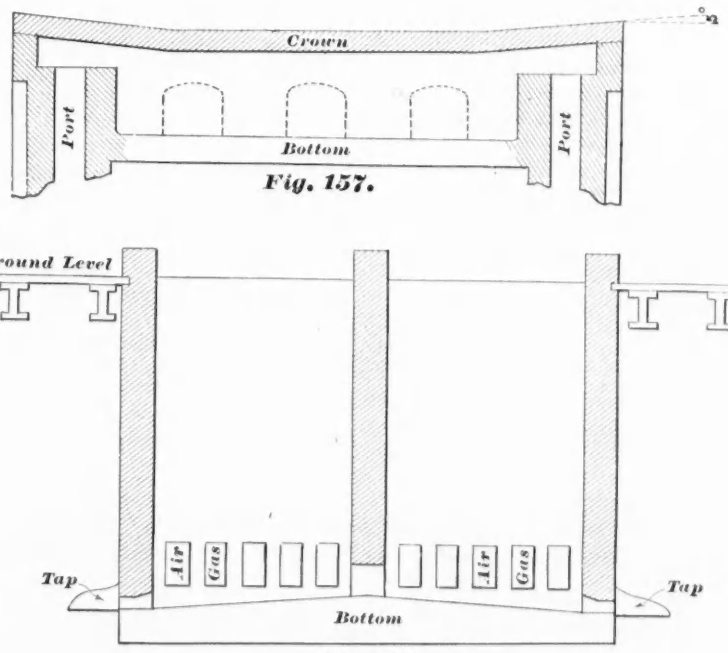


Fig. 157.

Fig. 158.

HEATING FURNACES.

To do good and careful heating, the bottom of the furnace must have plenty of attention, especially when the stuff is charged by a mechanical device. The scraping over the bottom soon tears it away. With good fire-sand and care there is no trouble in maintaining a clean, hard bottom, gradually sloping towards a tap-hole at the back of the furnace, midway from the end. This, besides being a help to the heating, makes charging and drawing easy. The bottom can be made and maintained with a slope towards one tapping-hole easier than to two or even three. A high place on the hearth can be cut down by putting some fine coal on it; the ash of the coal combines with and fluxes the silica of the sand.

The process of "burning down" a high bottom is injurious to the furnace, since it is necessary to raise it to such a high temperature that the bricks in the roof drip.

A sand with too much clay in it is liable to cling to a piece of steel all through the rolls, and show in yellow streaks on the finished bar.

When the cinder sinks into the blow-holes and unevenness of the steel, and then is lengthened into streaks in the working of it, the finished stuff is termed snaked. These snakes show to the prejudice of the steel when it is highly polished, as, for instance, in various weapons. A seam is where the metal is actually parted; it is generally called "piping." A low carbon steel stands nearly as much heat as iron. In heating high carbon steel the metal must be very gradually brought up to a heat sufficiently high for working it. To charge cold steel of high carbon into a warm furnace is disastrous to the metal, particularly when the steel is frosty. It is an easy matter to build a wood fire around the steel, and warm it throughout to at least 200° or 300° before charging. This will mitigate the strain on the inside when the outside begins to expand with the heat of the furnace.

A very fine steel, not too high in carbon, will scale off in sheets, while the scale from a high-carbon steel will break up into fine powder as it comes off. This can be more readily seen under the hammer than at the rolls, where there is generally so much water. Gas which contains steam oxidizes the steel and makes a good deal heavier scale than other gases, ordinarily from 1.25 to 2 per cent. on ingots charged hot.

Furnace crowns have been built on a great many different plans, but, after all, the one that gives the most satisfaction is a roof that dips about five degrees at each end for one-quarter the whole distance, and then straight across, with the necessary arch sideways for support (Fig. 157); or even a straight roof, with the necessary arch. A very rough crown obstructs the draught across the furnace; the unevennesses create eddies.

The height of the crown above the hearth depends somewhat on the size of the pieces to be heated, and, for cold metal generally, four or five times the thickness of the pieces. When the metal is only re-heated, it is not necessary to have the roof so high.

By exposing a piece of steel to too high a temperature in the furnace, a crystalline structure is induced, which renders the metal unfit for further hammering or rolling. The evil effect of this overheating is, partially at least, remedied by lowering the temperature to a point below that at which it is generally worked, and gradually bringing it up again to the right degree. This is attained by various devices, the most common of which is to pass a highly reducing flame over the hearth. When the steel is overheated or burnt to a greater degree, the burnt part is covered with a flat piece of wood, or some sand, a short time before drawing; and sometimes coke or charcoal dust is spread over the bottom of the furnace, and the overheated parts turned into it. Besides bringing about a lower temperature, all these methods shield the metal from oxidation. It is possible to restore steel and iron almost to what they were before being overheated, by working the piece a great deal. At its best, however, the metal is treacherous, and on any account it should not be used where much depends on its strength.

The top and sharp corners on the top side of a piece of steel are the only parts liable to become overheated. The bottom of the furnace being in contact with the under side of the piece, keeps it lower in temperature than the sides and top, so much so that it is necessary to turn the piece, that the under side may be on top a short while before drawing, in order that it may have an even heat. For these reasons, pieces of steel, at the stages in their working where they have to be re-heated, should be left in such a shape as to favor these things. The round corners on ingots, and the fillets in the grooves of blooming rolls, are in favor of both the heating and turning. A very large slab cannot be turned on the hearth in any convenient manner. In this case one end is propped up with a fire-brick, to give the flames a chance to sweep under it.

In a coal furnace for heating iron or mild steel the hearth has a gradual slope from the bridge to the velvetry, which is the hottest part of the furnace, and is tapped at the base of the chimney, giving advantage of all the bottom. For working steel the bottom is sloped toward a tapping-hole at the back, near the velvetry. The furnace is not worked hot enough to be tapped at the flue.

Various plans are put into practice to aid in burning the smoke and gases driven off a green fire. These are, however, generally abandoned after awhile, and the furnace is worked with simply a fire-box and forced draught, or a combination of natural and forced draught. In introducing these schemes for burning the gases, very often the advantages from them are over-estimated, and the grate surface is made too small. Coal furnaces are now built when it is not considered worth while to go to the expense of building gas producers. They are convenient at a hammer where a high heat is wanted for a short time; but, generally speaking, they have had their day. A coal furnace will not compare with a gas furnace, where an almost even temperature is held from week to week, especially when it only required to bring metal which is already warm up to a hammering or rolling heat.

Explosions are prevented, in starting up a gas furnace, by building a fire on the hearth

to heat the regenerators, and surely ignite the gas as soon as it flows out of the port and mixes with the air. The principal virtue of the heated regenerators is the creating of a draught. The chambers are filled with the gases from the combustion of the fuel on the hearth and air if an excess has been passing over, so that, when the gas is let on, the heated chamber causes it to ascend so rapidly that there is very little danger of its forming an explosive mixture with whatever air there may have been in the chamber. By introducing little trap-doors at each end of the gas valve-box, cold air may be admitted, with the outgoing current, to cool the gas valve. This checks the draught through the gas checkers to a certain extent, and sends an extra amount through the air. These arrangements are used in melting furnaces, and will hardly be found necessary in heating furnaces. Natural gas is not passed through regenerators, but introduced at the end of the furnace. There is no danger in turning it on when there is a fire on the hearth.

Vertical or pit furnaces are only used to reheat ingots brought to them soon after being cast. These furnaces save labor in charging and drawing, but they are not equal to horizontal furnaces for heating an ingot evenly. The greatest stumbling-block to be contended with in their working is the getting rid of the cinder, especially when low carbon steel is being heated. This is attempted in two ways—one in tapping through the bottom at the center of each compartment, and the other in sloping the bottom of all the compartments towards one end, where there is a tap-hole, the same as in an ordinary furnace. It is a difficult matter to keep this gradual slant, on account of the tendency of the bottom to pile up under the partitions that divide the furnace into compartments. Tapping through the bottom is the safest and best way of these two, if the tap-hole could be easily opened and closed. This draining off of the cinder is a most serious matter, as it so easily cuts its way down under the ports to the crown of the nearest regenerator chamber. Altogether the best design seems to be a pit with only one partition and a tap-hole at each end of the hearth (Fig. 158), with the regenerator chambers removed a safe distance from the bottom of the furnace. Although the ports are generally only a few inches above the bottom, and a sharp flame is liable to burn the butt-end of the ingot, there is no advantage in raising the ports. In fact, they do not heat so well when the ports are raised much above the bottom. These furnaces require, from different causes, a good deal of repair. Considering this and the disadvantage of having everything underground, it is a question whether they are more economical than horizontal furnaces. It might be added that it is possible to heat cold ingots in these pits, but it is not at all profitable.

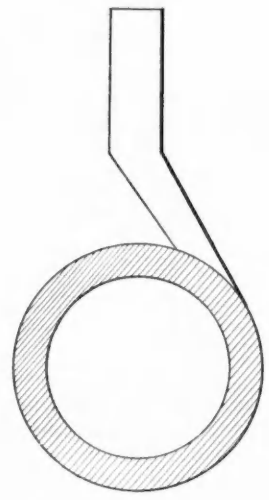
Soaking pits, of course, require no fuel, and the ingot is handled with more speed and ease than even in the pit furnaces, on account of only one ingot being put in a pit. In a soaking pit the ingot must be charged very soon after it is cast, so that there will be heat over and above what is necessary to give a uniform heat to the ingot, to furnish heat for that which is lost from the sides of the pit. It is possible to charge the ingots too soon after being cast; for instance, where they can be swung around and put in the soaking pits by the same crane that lifts them from the casting pit. When the bessemer is running very fast, there would hardly be room enough to let the moulds and ingots stand in the pit until the time that the ingots would be fit to charge. This can be avoided by casting in moulds mounted on a truck, and then taking the whole affair away from the bessemer to the soaking pits, within a reasonable distance (50 to 75 yards). While keeping the ingot on its end from the time it is cast till the time it is put on the table to be rolled, throws all the advantages on the side of the ingot, in cooling down from the liquid to the solid state, on the inside. By the nature of the case, the stuff is not likely to roll so well from a soaking pit as that which is heated in a furnace with fuel supplied to it. The inside is bound to be softer than the outside, and more yielding, and throws more strain on the outside, while being hammered or rolled, than is its share. The strain on the outside is not backed up by resistance on the inside, and so a weak place will give way to the strain, and crack. While in a furnace the outside is more likely to be as even as the inside, or even hotter, since the heat comes from the outside as well as the inside. In ordinary running at least 90 per cent. of the ingots from the bessemer could be cared for by soaking pits. This is a considerable saving of fuel, labor, first cost, and practically no repairs.

LETTERS FROM PRACTICAL MEN.

Making Rolls.

Editor American Machinist:

The cause of rolls being dirty and imperfect is due in a great measure to the manner



of gating. The gate should be made so the metal will enter the mould with a whirl; then the dirt will be forced toward the center, leaving the metal at the face of the roll clean. This is the result of my experience, which has been considerable.

The accompanying sketch will explain what I mean. WM. STUART.

Electric Welding in England.

Editor American Machinist:

A few days ago, having a spare hour, and hearing there was on view an electric welding plant in London, I betook myself there, and feel impelled to tell something of what I saw. The place where this remarkable machinery is on view is in Fanshawe street, Hoxton N., and, on arriving there, I found in charge Mr. Fish, an American engineer, who kindly carried out several operations for our benefit.

The apparatus on view comprises two machines for heating up the articles to be welded, and a pair of dynamos, one large—the Thomson welding dynamo, and one small, this latter being the separate exciter of the large machine.

The large machine is driven by a link-belt from a portable engine, and the small machine is driven off the spindle of the large one.

The welding machine itself consists essentially of a pair of heavy copper clamps of large section, forming the terminals of the large dynamo. These clamps are capable of being pressed toward each other. Above, at a height of two feet or thereabouts, is what electricians term a choking coil, a device for varying the amount of the high-tension current from the dynamo, which shall be converted into low-tension quantity current to pass. It consists of a specially arranged half-ring coil of wire, with suitable cut-out device, and is actuated by a simple lever, almost like the throttle lever of an English locomotive. This handle does all that is needed in regulating the heat of welding.

When a piece has to be welded, as, for instance, a pair of one-inch bars; each bar is clamped in one of the clamps and screwed fast by the hand-wheel, by which it can be instantly released.

The ends to be welded are, of course, first cleaned up, and the clamps are approached until the bar ends are in contact; the current is then let on and the bar ends begin to glow, and, as welding heat approaches, they are pressed more and more closely together, and the line of junction lightly hammered by a small hammer. When full welding heat has been attained, the bar ends present something the appearance of Fig. 1, but not so much set up as this shows them. The weld is then perfect, and, the bars being released, the current being stopped, the weld is swaged down in the ordinary way on the anvil. Mr. Fish welded for me two pieces of so-called "unweldable tool steel," using simply powdered borax as a flux, and securing a weld which bore to have the steel bent double in the vise with the weld at the point of most severe bending.

To show the capacity of the process, a piece of hydraulic tubing was welded up. The parts to be united were formed as shown in section in Fig. 2. The weld was perfect, and full bore of the tube was preserved. Copper and aluminium wires were welded up, and there seemed no limit to the applications for at least plain, straight work, such as joining on new ends to old boiler tubes, welding hard steel to iron, or inferior steel for special tools, and one piece of work done in my presence was the welding up of a ring. It was rather curious that the electricity would pass by the way of the ends to be welded rather than go around the ring, but so it was in this case of a ring about eight inches diameter. Chain links can be welded by this process. When small they are welded of halves, as in Fig. 3, both welds being made simultaneously, and even cast-iron can be welded easily.

Cast-iron is, of course, capable of making a more perfect junction by welding than is wrought-iron, but then the welding heat of cast-iron is that of liquidity, and the process is only possible by actual fusion, or by the well-known foundry dodge, of "burning." In the electric process the welding of cast-iron takes place simply by the actual fusion of the surfaces in close contact, and this fusion does not extend deeply along the bars being welded, and so junction is effected without general melting.

By means of the electric process the art of welding becomes decidedly a machine shop job, and fairly cleanly—no smoke, no coal, no bellows, no showers of flying sparks, and not an enormous call for the hammer, in small erections especially, which weld instantaneously, and, if too heavily pressed together, appear as in Fig, 4, the pressed out ridge of metal being clipped off by nippers.

The cost of the process must depend largely on the constant supply of work to be done,

Fig. 2.

Fig. 1.

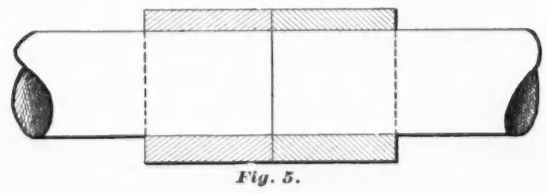


Fig. 5.

Fig. 3.

Fig. 4.

ELECTRIC WELDING.

but cannot be great when a continual supply of work is to hand. There is no waiting for a heat; the welding heat is gotten up right inside the very heart of the bar, and has not to penetrate from the exterior. It is therefore an absolutely uniform heat throughout, and the work done is by so much the more perfect; and, leaving alone the question of cost, the process is sound and mechanical, and appeals to one's perceptions as a sound process very quickly. The work is done before your eyes in broad daylight, and you can try it up yourself, and prove its excellence.

A deal of modification from the plain bar machine will be required for adopting the process to welding large wide plates, for boiler shells, for example, but I see no physical reason against the welding of plates by the electric process, or the welding of heads to bars to form bridge eye bars, connecting rods and similar articles, often made by adding a finished head to a straight bar. The process would seem to be applicable to welding telegraph wires in the field.

Most curious of all was the welding of a solid wire cable without destroying its flexibility at the weld. Over each end of the cable, carefully squared off and clean, is slipped a thimble or collar, and the two ends are then forced together just as if a solid rod were to be pieced.

The two collars unite, and the two cable ends unite, but the collars do not weld, curious to say, to the cable, and, when complete, the collar is cut open by a chisel and removed, and leaves the welded cable beneath good, and apparently quite serviceable and strong, each wire seeming almost to have united individually with an opposite wire. This was most instructive, and stamps the process as possessed of a high range of applicability and power, and one the end of which is not yet.

W. H. BOOTH.

Grinding Clearance on Screw Tool.

Editor American Machinist:

To your answer, in May 15 issue, to a question as to the rule for grinding the proper clearance of tools for cutting square threads and worms, it would have been well to add that the top face of the tool should be, at least approximately, at right angles to the line bisecting the clearance angles. The top as well as the sides of the tool should be adapted to the relatively inclined movement. The necessity for doing this becomes most apparent when the thread to be cut has a large pitch in relation to its diameter. Without this precaution the cutting of steep threads is actually impossible.

HUGO BILGRAM.

[Mr. Bilgram's point is well taken. We are pleased that he has called attention to it.]

Wants More Discussion on Tools.

Editor American Machinist:

In your issue of May 15, "Tool-room" gave a very interesting though brief paper on shop practice, and I for one want to see more of it. I have seen the combined drill and center reamer, but have thought it would be difficult to keep the reamer ground to just the center angle, so I use the half-round style after the drill. With a lathe center grinder in place of the tool-post, and compound rest at 60°, am sure of a true center, and by grinding the reamer at the same time am sure also that the tapers agree. If I am not mistaken, "Jarno" advocates hardened centers for both spindles, and as I have used them hardened several years, I can agree with him fully. By keeping an extra pair in good shape (and the every-day pair need not be allowed to become badly worn, for it is but a few minutes' job to true them up) you can be sure of good work, and a spare center is often very handy to have.

In designing a tool-post grinder, it should be borne in mind that, to obtain the angles as indicated on a compound rest, the center of emery wheel spindle must be the same height as the lathe spindle, the well-known laws, if they may be so-called, of tapers, holding good here as in turning.

Most readers will remember the tool-post grinder I described several years ago. It is in use yet, and doing good work, as it always has, and is one of the handiest and most useful adjuncts any tool makers' lathe can have. This is one place where the grindstone must take a back seat. To the tool maker in any small shop there is no handier tool—for with it can be ground flat drills to special size, ground in the drill chuck so they must run true; and the lip can be given also so it will cut evenly and true; its range of usefulness seems to spread the longer you have it. Tool makers' milling tool is very nice, but we don't all have those machines, and a good emery wheel answers the purpose in my case.

"A Mechanic" makes some good points, but on many I am more of "Jarno's" turn of mind, and think universal tapers a thing to be desired, and his system was rational and practical—decimals wherever practical are the best.

It is hard and probably impossible to have lathe centers made in one place fit other lathes *exactly*. A standard taper will help—but, as metal will wear from constant use, it seems hardly probable that the *exact* taper can be maintained year after year, even in the same shop. For tool lathes where work is measured by thousandths, a very slight variation in the fit of the center will be noticed, but ordinarily they might interchange without any detrimental effect. This is especially true of Fox lathes, where very little work is done between centers, the back head being used for "hook tools," and these it is often desirable to interchange. Cases of this kind can be found in many shops, where, after having a few lathes of one make, they get in some new ones, and find the centers are different, necessitating new back head tools that won't interchange, special shanks for drill chucks, etc., etc., till they wish the maker had stuck to the old standard, even if it wasn't the Morse taper. Hope we shall see more from "Tool-room," as it is most welcome, and a good field for discussion.

FRED H. COLVIN.

Strength of Teeth.

Editor American Machinist:

I have been very much interested in Mr. Geo. B. Grant's capital series of letters on gearing, and the one in your issue of May 15 recalls a long "wrestle" I had with the subject, about six mouths since, taking for my text the same Franklin Institute paper of Mr. Cooper's, to which he refers.

A careful study of that paper showed me that the very discrepant formulæ there quoted covered a range of strains, varying from that on one corner of one tooth, as shown in some of the early English rules, to that of two teeth in full bearing, as in Nystrom's later formulæ. I took Mr. R. E. Masters' letter to the AMERICAN MACHINIST, of Oct. 3, 1889, and reduced the tests there given from Messrs. Rogers, Meacham and Shields, to the breaking weight on a cantilever of 1″ cube, supported at one end, and the strain applied at the other. This gave me the following figures:

	11.536 lb.
	5.040 lb.
	9.180 lb.
	6.726 lb.
	7.278 lb.
	7.824 lb.
	8.754 lb.
	7.470 lb.
	7.974 lb.
	8.478 lb.
	9.684 lb.
11)	89.944 lb.
Avge.	8.177 lb.

Rejecting the abnormal ones, I thought it safe to assume the breaking strain of good American cast-iron at 7,500 lb. per inch, under such conditions, instead of the 7,200 lb. employed by Boulton & Watt as a basis.

Then assuming a factor of safety of 15 to 1, as they did, I get 500 lb. as the perfectly safe strain, under any circumstances. I then endeavored to work out a formula from this basis, by calculation and cancellation, and reached this very simple one, H. P. $= t^2\ v \times 5$, differing only from one of Haswell's in using the coefficient of 5 instead of 5.45.

In the paper of Mr. Cooper's, referred to, he works out some of the formulæ, in the case of an imaginary gear of 3″ pitch, 5 ft. diam. at pitch lines, 7½ in. face, and 60 *r. p. m.*, thickness of tooth 1.38″, and velocity per second 15.708 ft. The results are as follows, n being number of revolutions per minute.

Boulton & Watt's formula, H. P. $= P^2 \times f \times d \times N = 66.17$ H. P.

Haswell, 1st formula, H. P. $= v\ t^2 \times 5.45 = 163$. H. P.

Webber, formula, H. P. $= v\ t^2 \times 5 = 149$. H. P.

Haswell, 2d formula, H. P. $= b \left(\frac{t}{.465}\right)^2 = 138.23$ H. P.

Jones & Laughlin, formula, H. P. $= \frac{p \times d' \times f \times n}{550} = 147.27$ H. P.

Grant, formula, H. P. $= p^2\ f \times \sqrt{\frac{D' \times n}{30}} = 138$. H. P.

Nystrom's two formulæ are based on a factor of safety of 8 to one for one tooth, or 16 for two teeth, which may be assumed to be in gear in a large majority of cases, and read as follows:

$$\text{H. P.} = \frac{t\ f\ v}{.55} = 295.59,$$

$$\text{and H. P.} = \frac{t\ f\ v}{1.2} = 294.52,$$

the latter agreeing exactly with Jones & Laughlin.

It will be seen that Mr. Grant's formula, though differently stated, agrees with one of Haswell's; and mine is very close to Jones & Laughlin, and Nystrom's, and with the factor of safety allowed, there is a sufficient agreement in all of them. As I have but recently sent to the Journal of the Franklin Institute, a yet unpublished review of this question, I will not dwell upon the details any longer, but would advise such of your readers as may be able, to read Mr. Cooper's paper, and note especially the remarks of Mr. James Christie, of the Pencoyd Iron Works.

In the paper which I have sent, I have included a quite full table, of the safe load for gears of different sizes, at different velocities, from my formula.

SAMUEL WEBBER.

Thinks it is not New.

Editor American Machinist:

In the last issue of your valuable paper I read with a great deal of surprise about a new gauge cock. The device is quite old to me, and certainly to many of your readers too. The only difference or improvement I see is the arrangement for bringing unused parts of the packing into play. The sketch I enclose shows a gauge cock that has been used for a number of years on lake service. I have myself seen it on the steam tug "Ross" at Fair Haven, N. Y. K. ZIMMER.

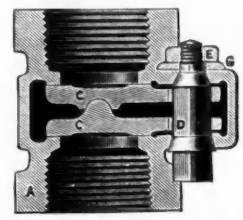
[We do not reproduce the sketch, because it shows a construction common for the past twenty years, viz., a gauge cock that is opened by raising a weighted handle. But the difference between the gauge cock we showed, and the sketch sent is very apparent. In the one we showed there is a seat that can be turned around so as to, in effect, make twenty or thirty new seats, while the sketch sent shows a lead seat that is a fixture. There are points of similarity in steam engines, for example, yet one may, and does, differ very materially from another, and the same is equally true of gauge cocks.]

Erasing Lines.

Editor American Machinist:

It is sometimes necessary, unpleasant as it may be, to erase inked lines, especially on patent office drawings. The erasing is well enough, but to draw lines over the erased spot, and to be as distinct as any of the other lines of the drawing, is accomplished by erasing the lines carefully without making ditches; then apply with a brush a thin solution of gum arabic with half that of alum; when wet, the paper will swell. After perfectly dry, burnish down, and it will be as good as ever, and often better than the paper, for this varies in quality. If the drawing is to be very elaborate, and tinted, it is best to test the paper as to its quality, before any inking is done, and apply with a sponge a very thin solution of the same liquid evenly, not let it run into the paper if pools are formed, but remove them—as everybody, I suppose, knows, the paper not being sized in this manner before the drawing is made, will shrink and change the scale—certainly poor paper wants a better treatment than good and homogeneous paper. HERMAN T. C. KRAUS.

FIG. 1.



STRAIGHTWAY VALVE.—FIG. 2.

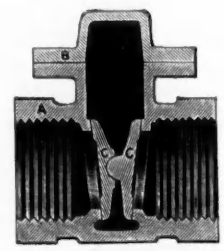


FIG. 3.

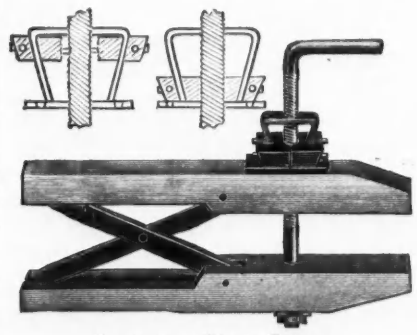
A New Straightway Valve.

We present herewith a perspective and sectional views of a new straightway valve which possesses some novel features.

Fig. 1 is a perspective view showing its outward appearance and the lever by which it is opened or closed, this being done by a single movement. The lever fits upon a square in such manner that it may readily be removed or placed in the most convenient position for operating.

The stem *D*, Fig. 2, to which the lever is attached, has two conical seats to which it is ground and may be kept tight by the nut *E*. Its central portion is squared and fits square holes in the disks *C C*, so that when the stem is turned these disks are swung down onto the seats or up into the chamber provided for them, as shown by Fig. 3, leaving an unobstructed straight passage.

The two seats are inclined to each other in such a manner that the disks wedge in to make the valve tight, even seating all around being secured by ball and socket joint at the center of the disks, by which each is made the abutment for the other.



IMPROVED HAND-SCREW.

Both the sectional views are longitudinal, Fig. 2 being through the center of the stem *D* and Fig. 3 a vertical section through the center of the chamber into which the disks are swung when the valve is opened.

It will be perceived that this valve is very simple in construction, and that the threaded stem and stuffing-box with its packing are entirely dispensed with. Any desired friction can be put upon the movement of the stem by means of the nut, so that the valve can be made to stand at any desired opening.

The valve is easily taken apart when necessary, by removing the nut from the stem, which can then be drawn out and the disks removed by taking off the cap *B*.

These valves are being made in brass in sizes from ¼ in. to 3 in., and in iron from 2 in. to 6 in. inclusive, with screwed ends, and are adapted for steam, water, gas, oils, etc., though sizes larger than 4 in. are not so well suited to steam above 80 pounds pressure. They are smaller than globe valves of the same nominal size, and, when placed near the ceiling or in other inaccessible places, can be operated by a rod or rope.

The maker is the Lunkenheimer Brass Mfg. Co., Cincinnati, Ohio.

An Improved Hand-Screw.

The illustration presented herewith shows the construction of a new hand-screw, in which only one screw has to be turned, and that for a small part of the movement only. The screw, which is made of machinery steel, is bent at right angles to form the handle, and is provided with an open nut of brass or steel, the two halves of which are joined together by a pin upon which they slide, and that serves to keep them in line one with the other, while they are opened or closed upon the screw by being moved in or out upon the guides shown in the small sectional views at the left.

When handling small work the clamp can be turned over either way to make the nut close or open by gravity, while for larger work, where this is not convenient, it is easily moved by hand. A "lazy tongs" arrangement keeps the jaws always parallel. In using this hand-screw the jaws are placed the desired distance apart, without turning the screw, when a turn or two tightens them.

The maker is B. B. Powell, Grand Rapids, Mich.

The World Filling Up.

According to Mr. Giffen, a few generations more will see the end of emigration, because there will be no room for more emigrants, all the blank habitable space having been occupied. Mr. Giffen is a master of statistics; but his manipulation of figures in support of this rather dismal theory is open to objection. Take the case of the United States—at the present time the most attractive emigration field. Uncle Sam's territory, exclusive of Alaska, amounts, speaking roughly, to about 3,000,000 square miles. One third of this Mr. Giffen deducts as uninhabitable; but, if ever the rest of the country becomes as populous as western Europe, the Americans will soon find means of utilizing and fertilizing their sage-brush and alkali deserts. Then, of the remaining 2,000,000 square miles, he says that only about 100,000 square miles remain to be cultivated, implying that that is the only tract open to the agricultural immigrant. But any one who has visited that "great sloven continent," as Nathaniel Hawthorne styled America, will know that, although the remaining nineteen-twentieths have been alienated from the State, and have become private property, only a small percentage of this area is cultivated, in the sense in which cultivation is understood in such countries as England, France, Holland and Belgium. In the State of New York alone, despite the big city at its southern extremity, there are hundreds of square miles of wild land—land which could and would be cultivated, if the pressure of population needed it. Depend on it that the United States, and still more Canada and Australasia, will need an abundance of strong, willing hands for many a year to come; and we only regret that the working classes of our nation (that is, the English, as distinguished from the Irish, the Scotch and the Welsh) show at the present time so little desire for emigration. England alone ought to send out at least 300,000 emigrants yearly; and, in their new homes, they would do more to preserve the unity of the empire than any artificial federation schemes.—*London Standard.*

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Cincinnati Meeting of the Mechanical Engineers.

The May meeting of the Mechanical Engineers Society at Cincinnati was generally considered by those present to have been a very profitable and pleasant one.

The attendance was very good, all portions of the country and most of the leading branches of mechanical engineering being represented. Most of the professional papers presented were excellent, and many of them called out discussion equally able, the discussions presented in writing being unusually numerous and thoughtful. Looking over the list of papers, and taking into consideration the method of treatment of the several subjects, it is evident that a very good balance was maintained between the purely theoretical and the purely practical, though there were those present who expressed the opinion that the general inclination was a little too much one way or the other, according as the personal preferences of the critic inclined. We think, however, that things were pretty evenly divided in this respect, and it is undoubtedly advantageous to the society and its members, that the theoretical men—those who study mechanics from the theoretical side only—should meet and discuss matters of common interest with the practical men who know little or nothing of purely theoretical matters or abstract mathematics. The work of one class of men supplements, and is complementary to that of the other. Then it is to be remembered that papers are invited from all the members of the society, each member having as much opportunity for their presentation or for discussion as any other, so that if the so-called practical men, as distinguished from the other members, find too many abstract and purely theoretical papers to suit them, they have the remedy in their own hands—they have only to submit more papers themselves, and this is a rule that works equally well either way.

As noted in our report of the proceedings, the rules regarding the limit of time allowed for presentation and discussion of papers do not in practice work quite as well as might be wished for, and some member of the society might do it a good service by devising some form of clock which should stand on the president's desk, and, being set in motion at the time a member takes the floor, show plainly just what time has elapsed, and what remains, automatically striking a bell at the expiration of the allotted time. There would be many advantages in such a monitor, even without the brick-throwing attachment which some of the members might possibly be disposed to add to it.

Many of those who attended would have been more comfortable if there had been somewhat less crowding at the hotel where the headquarters were located. So many were there that the dining-room service was simply wretched, and, in many instances, seriously interfered with the plans of members by delaying them at table. It would be better if a greater proportion of members attending would conceive the idea that other hotels may be as good as the one mentioned as headquarters.

A Water Famine in Cincinnati.

The mechanical engineers who visited Cincinnati, during the recent meeting there, had an excellent opportunity for studying the subject of "how not to do it" by going to the water-works and seeing the condition which men who were politicians, rather than engineers, had allowed the pumping machinery to get into.

The spectacle of one of the leading cities of the country being reduced to the very verge of a serious water famine by the criminal negligence of those whose business it was to see that everything in any way connected with the service was kept in the best possible condition, was not an edifying one.

We do not know what particular party the men who allowed this state of affairs to obtain belonged to, nor do we care; it is enough to know that, while the more contemptible and petty details of political work were being attended to by men whom the city paid for taking care of its pumping machinery, that machinery was not being taken care of, with the result that many thousands of dollars have been literally thrown away and the citizens subjected to much inconvenience and even serious danger.

Such occurrences are of course always seized upon and made the most of by those who think that our modern cities should depend upon private corporations for their supply of water, gas, electricity, etc.

Such things do not, however, constitute a conclusive argument against municipal ownership and control of such matters any more than one swallow makes a summer. Where one such instance can be found, dozens can be pointed out where cities own and control their own water-works with the best results. The only moral which can be drawn from such occurrences is that there is no such thing as Democratic or Republican, or even Prohibition management of water-works machinery. There is good management and bad, and the thing to be done is to see that the former is strictly required, regardless of politics.

At this writing the board of experts employed to make an examination of the machinery at Cincinnati have not yet handed in their report, and a sufficiently thorough examination could not well be made by others on which to base a reliable account of the trouble; but enough has been ascertained to make it evident that in some cases, where several large pumping engines were arranged to deliver through a single main, one or more of them are and probably for some time have been so badly broken that most of the water pumped by the others has escaped through the broken ones, back into the river.

Cincinnati is having a severe lesson and gaining considerable expensive experience regarding the politicians' management of such affairs, experience which it is to be hoped will at least serve the purpose of aiding to cause the more general employment of competent engineers untrammeled by political matters to take responsible charge of such affairs there and elsewhere.

Principles vs. Policy.

It is no uncommon thing for holders of stock in large corporations to rather felicitate themselves upon the fact that the affairs of the company are under the management of a man whose first and only thought is how to make the money with which to declare liberal dividends, and who is not over-particular as to the fairness or even honesty of the methods by which it is made. Many of the stockholders in these companies would not themselves be guilty of doing the things by which their money is obtained, yet they easily persuade themselves that, so long as some one else engages in various kinds of sharp practice or rascality, and a share of the money made thereby is turned over to them, there can be no great harm in their acceptance of it. One of the favorite conscience-easing considerations in such cases is to reflect that, if the stock is sold, and one's hands thereby washed of the business, it will only result in some one else getting the dividends, and the rascality will go on just the same. Of course, in spite of such specious reasoning, the fact remains that a holder of stock in a company which engages in dishonorable practices is morally responsible for those practices, and can only clear himself by reforming them or getting out of the company.

But an argument which may prove stronger with many persons than any founded upon moral considerations is to be found in the fact that, where a man is placed in charge of the affairs of a company, who is not governed at all by principles of honor in his dealings with people outside of the company, it is entirely safe to conclude that he is not so governed in his dealings with the members themselves.

An honorable man is always governed by his principles of honor. It is utterly impossible for such a man to deal honorably with his business associates, and then lay aside his principles when dealing with others. If he is controlled only by motives of policy in the one case, it is absolutely certain that he will be controlled by the same motives in the other case, and that he will commit a dishonorable act as quickly in one as in the other, whenever he conceives the idea that he will be the gainer thereby. If such a man deals honestly in a given transaction, it is only because he believes that for that particular occasion honesty is literally the best policy, and whenever an occasion arises when he thinks that dishonesty is the best policy he will not hesitate to be dishonest, no matter whether at the time he may happen to be dealing with his business associates who have reposed confidence in him, or with others. An honorable man acts honorably upon every occasion, and regardless of circumstances. One who does not do this is not honorable, and cannot be safely trusted by any one, whether business associates or not. A man who deliberately does a dishonorable act in order to gain an apparent advantage for the company he represents, will do a dishonorable act which he knows is to its disadvantage, whenever he thinks he will be the gainer thereby.

Not all wrong acts are dishonorable, because a person of the very best intentions may occasionally make a mistake, which, however, if an injustice to others is involved, he will rectify, at whatever cost. But where the nature of the business carried on is such that it is known that a disregard of the prickings of conscience is necessarily involved upon the part of some one in a responsible position, then it is well to look out for the property intrusted to his care, for the continued disregard of the promptings of conscience will produce their inevitable result. It would be very interesting to know just how many defalcations and hasty flights to foreign lands are attributable to the fact that the defaulter had for years, either voluntarily or under pressure, seared his conscience by acts in the interest of his employer, which he knew to be unfair to others, if not positively dishonorable. And the same principles hold good down to the humblest employe or apprentice boy.

The *Locomotive* for May has accounts of twenty boiler explosions, five of which were in saw-mills; we back the saw-mill for keeping up its record.

Correspondents whose contributions contain mathematical formulas will confer an especial favor by writing their formulas very plainly. The editor, like other mortals, sometimes lacks time to verify formulas, and the compositor and proof-reader cannot be expected to successfully wrestle with the intricacies of the signs indicating addition or multiplication, when there is no difference in form between the two. Similarly, when a letter may be *a* or *d*, or something else, it is liable to appear wrong in print.

Many large cities in this country have their water supply contaminated by sewage discharged from other cities above their source of supply. This can be entirely avoided, as is done in many places in Europe, when all offensive matter is precipitated and used as a fertilizer, and the fluid matter enters the river clean enough to drink.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(197) G. T., New York, asks: How do you find the diameter of a circle when its circumference is known? *A.*—Divide the circumference by 3.1416; the quotient will be the diameter. You will find this rule given and explained in nearly all elementary arithmetics.

(198) D. O. M., Toronto, Ont., writes: Please inform me what per cent. of oil of vitriol and water I should use to obtain the best pickle for cast-iron so as to get it clean for tinning. *A.*—One part of oil of vitriol to seven or eight of water, to remove the sand.

(199) C. P. C., Providence, R. I., asks: Please inform me of a treatise on the mixing and melting of brass; in fact, everything pertaining to a brass foundry, and where it can be procured. *A.*—Larkin's Brass Founder. You may procure it from any dealer in scientific works.

(200) Reader, Rochester, N. Y., writes: Please give a recipe for a solution to dip brass work in, to remove the rouge and tripoli which we use for polishing, so that we can lacquer the work. *A.*—Try a mixture of aquafortis and water sufficiently strong to take off the rouge and tripoli; wash the work afterwards in clean water.

(201) F. H. W., Pittsburgh, Pa., asks: What size of propeller will I need for a launch 60 feet long by 8 feet beam, 4½ feet deep; engines, 18 horse-power? The lines of the boat are fine. Also, what will be the speed of the boat? *A.*—Propeller, 30 inches diameter and 42 inches pitch. Speed of boat, about nine miles per hour.

(202) R. F., Lawrence, Mass., asks: How much power is required to pump three gallons of water per minute against sixty pounds steady pressure? Pump is 1¼-inch bore and 3 inches stroke, double-acting. *A.*—About .2 of a horse-power. 2. How many revolutions should the pump crank make? *A.*—About fifty per minute.

(203) W. J. O. J., Columbus, Ohio, asks: If I wish to cast a cylinder two feet long and 12 inches outside diameter, what size core should be used to give a ten-inch hole, allowing for shrinkage? *A.*—The size of core will depend to some extent on the quality of the iron. We should make the core about ten and one-sixteenth inches diameter. If the cylinder has to be bored the core will have to be smaller in diameter.

(204) Reader, Brooklyn, N. Y., writes: Will you kindly decide? A bets B that Swedish iron is wrought-iron; B, that it is not. Who is right? *A.*—Swedish iron we generally understand to be wrought-iron; it is a tough iron, and can be bent frequently without apparent injury. The tensile strength of Swedish bar iron is about 48,000 pounds per square inch. Undoubtedly you can buy Swedish cast-iron, but in this country the term "Swedish iron" without any other qualification is usually understood to mean wrought-iron. We believe that A is right.

(205) A. G. T., Aberdeen, S. D., writes: To settle a dispute please state what high-pressure and low-pressure engines are. *A.*—The term "low-pressure" engine was formerly applied to condensing engines, and the term "high-pressure" to non-condensing engines, but now these terms have gone out of use, as there is no definite meaning to them. A condensing engine using steam of 100 pounds pressure may be called a high pressure engine when compared with one using a pressure of 50 pounds, but the former will be a low-pressure engine if compared with one using 150 pounds.

(206) P. J. D., ———, writes: I had an argument with a friend of mine in regard to boiler metal. He claimed that the best metal for boilers was made in Scotland, and that all the boilers for the big Atlantic steamers are made in Scotland. I claimed that we can get just as good iron in this country. But, to offset my argument, he pointed to a mill in which five new boilers are now being erected, and the iron for these has been bought in Scotland. Please enlighten me on the subject. *A.*—We can and are making just as good boiler iron in this country as in Scotland or anywhere else. The reason for building the boilers for the Atlantic steamers in Scotland is that the engines and hulls are built there, and can there be built a little cheaper than in this country, but not any better. As to the five new mill boilers to which you refer, it may be that the owners were able to obtain the iron in Scotland and import it for less money than they could have bought it here, or prejudice might have influenced them.

(207) H. H., Indianapolis, Ind., sends us a rough free-hand sketch of a steam tricycle, and gives the following description: Boiler is 2 feet diameter and 2 feet long; it has 28 flues 1½ inches diameter; fire-box extends the whole length of boiler and half-way around it. Oil for fuel. Capacity of oil tank, 7 gallons. Two cylinders, 2½ inches bore by 3 inches stroke; they are coupled to a shaft running across the back end of boiler; this shaft is connected to the driving wheel shaft by a chain belt. The back seat serves as a water-tank, and has a capacity of 2 cubic feet. I intend to run with an average pressure of 80 pounds, but more, if needed. Driving wheels, 3 feet diameter. The machine, when finished, will not weigh less than 600 pounds. Our correspondent wishes to know if the driving wheels are too large, and whether the machine is proportioned correctly for running ten miles per hour on a good road. *A.*—The diameter of the wheels is correct, and the other proportions given in your description are also correct for a good, smooth, level road. If the road is rough or hilly, the boiler will be too small for a speed of ten miles a hour.

(208) H. S., Providence, R. I., writes: Please inform me if there is a guide-book published for machinists who desire to study for a license to act as engineers on sea-going steamers. *A.*—We do not know of any book that treats specially on this subject. An examination for an original license will not be very severe; with an ordinary school education and such practical knowledge as you can obtain during the time of service in practical work, which is required before a license will be granted, should enable you to pass the examination without much trouble. In the general rules and regulations prescribed by the Board of Supervising Inspectors of Steam Vessels we find the following: "No original license shall be issued to any person to act as engineer, except for special license on small pleasure steamers, who cannot read and write, or who has not served at least three years in the engineer's department of a steam vessel, or as a regular machinist in a machine works, provided that any person who has served for a period of three years as a locomotive or a stationary engineer may be licensed to act as engineer on steam vessels after having had not less than one year's experience in the engineer's department of a steam vessel."

(209) H. W., Cleveland, O., asks: In what does green moulding sand differ from loam? Where is it from? What is its value? And what kind of castings are made in it? *A.*—The terms "green sand" and "loam" have exclusive reference to mixtures and physical conditions; none whatever to geological character or to locality. Sand is "green" when the mixture is used in its natural condition, that is, damp, or mixed with just sufficient water to render it coherent. Immediately after the pattern is withdrawn therefrom the mould is ready, except for the necessary cleaning and mending up, and blackening to receive the metal. Loam is composed of dry sands and manure, and, instead of being rammed like the green sand, it is wrought up wet, similarly to mortar, being either struck or swept up with boards, or daubed around patterns or sections of patterns. The character of the casting to be made will decide whether green sand or loam moulds are to be used. The sands for all these mixtures can be obtained in almost any section of the country. For the price of the sands apply to the dealers. 2. What is the meaning of the term "chipping piece" applied to castings? *A.*—A chipping piece or strip is simply a raised portion of the casting, put on for the purpose of enabling the workman to chip, file or plane a comparatively small surface in fitting up a machine.

(210) L. E. B., New Orleans, La., writes: I have a superheater for exhaust steam placed in flue between my boiler and chimney. The superheater is made of boiler tubes 3 inches diameter, No. 12 B. W. G., and contains 2,800 lineal feet. How many lineal feet would I require to superheat the same quantity of steam to the same temperature when using cast-iron pipe 3 inches diameter and copper pipe 2 inches diameter? *A.*—The conductivity of wrought-iron and cast-iron of equal thickness is practically the same in both. But, in order to insure a good casting, the metal will have to be made thicker than for wrought-iron pipes; hence the transmission of heat in the former will be slower than in the latter, and the rate of transmission will depend on the thickness. Cast-iron is a poor metal to use for your purpose, because, on account of the increased thickness, it is liable to be burnt and ruined. The conductivity of copper is nearly two and a half times as great as that of iron, consequently the heating surface in the copper pipes may be reduced in the same proportion. The iron pipe is 3 inches diameter, the circumference of which is 0.78 of a foot; there are 2,800 lineal feet, hence the total heating surface of the iron pipe is 2,184 square feet. Assuming the conductivity of the copper to be two and a half times as great as that of iron, we shall need a heating surface in the copper pipes of $\frac{2184}{2.5} = 873.6$ square feet. The copper pipe is 2 inches diameter, its circumference is 0.52 of a foot; consequently the lineal feet of copper pipe required will be $\frac{873.6}{0.52} = 1{,}680$ feet. Here, of course, it is assumed that the copper is of the same thickness as the iron. But it should be observed that the assumed conductivity is for copper perfectly clean. It has been found that all metals conduct heat about alike when their surfaces become dull. The pipes soon become coated with soot, and therefore there will be very little or no advantage gained by using copper pipes in place of iron ones.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Mech'l Drawings; best; cheap. Box 457, Reading, Pa.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 155 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

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Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Milling Machines. Pedrick & Ayer, Philadelphia, Pa.

Universal Grinding Machine. Pedrick & Ayer, Philadelphia, Pa.

Standard Tool Co.'s Twist Drills. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Steel Name Stamps, etc. Address W. G. Sackmann, 1099 First ave., Cleveland, O.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Well-drilling Machinery and Tools. Williams Brothers, Ithaca, N. Y.

For Pattern Letters, Steel Stamps, Burning Brands, Mach'y, Plates, &c., A. A. White & Co., Prov., R. I.

F. C. & A. E. Rowland, New Haven, Conn. Hydraulic, Mill and Special Machinery to order.

Send to H. W. Knight & Son, Seneca Falls, N. Y., for Catalogue of Pattern Letters and Figures.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N.Y.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See May 1, p. 14. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

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Patents.—Patent soliciting of high class. D. Walter Brown, 31 Nassau st., New York. Send for "A Brief History of Patent Legislation in the United States."

25" Upright Drills a specialty. Finely made, 28" great capacity, quickly operated, prices low. 32" Send for list of firms using our Drills. J. E. 36" Snyder, Worcester, Mass.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines, Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888 Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices' contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

Montgomery & Co., 105 Fulton st., New York City, have just issued a small catalogue of 160 pages, containing description and prices of many useful tools. A copy will be sent free to any address upon application.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Practical Drawing." By. J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

Screw Propellers. Manufactured by H. B. Roelker, 22 Cortlandt st., New York. Superintendent of the late De Lamater Iron Works, of same patterns and designs as before, adapted to each vessel. Consulting Expert and Constructing Engineer. Estimates on machinery, damages, etc. Air ice machines.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES.

The Phœnix Iron Works, Meadville, Pa., will increase their plant.

George B. Nickerson will build a furniture factory at Detroit, Maine.

The Peabody Mills, Newburyport, Mass., will have a new boiler house.

The Valley Iron Works, Williamsport, Pa., will remove to Lynchburg, Va.

J. R. Howell and others will erect a planing and shingle mill at Franklin, Va.

Blake & Johnson, machinists, of Waterbury, Conn., will build new shops.

Rodimer & Co. will erect a hub and spoke factory and planing mill at Gallatin, Tenn.

G. R. Lombard & Co., Augusta, Ga., are adding new machinery to their machine shop.

The Reidsville Cotton Mill Co., Reidsville, N. C., has increased its capital stock to $150,000.

The Overman Wheel Co., Chicopee, Mass., has broken ground for an extension of buildings.

The Scotland Neck (N. C.) Cotton Manufacturing Co. has decided to put in knitting machinery.

The Daft Electric Company are furnishing about two hundred horse-power service in Newark, N. J.

A stock company is being organized by W. A. Wilkins, to erect a planing mill at Waynesboro, Ga.

It is said that the owners of the Lookout Rolling Mill have decided to locate at New England City, Ga.

The Ashland Knitting Company, Ashland, N. H., has increased its capital stock from $30,000 to $50,000.

The Chester (S. C.) Manufacturing Co. is considering an increase of capital stock from $100,000 to $200,000.

The Chantrall Tool Company, of Reading, contemplates erecting large hardware works at Pottstown, Pa.

R. H. Towers has purchased the Birmingham (Ala.) Bridge and Bolt Works, and will add new machinery.

The Spartan Mills, Spartanburg, N. C., has changed its authorized capital stock from $500,000 to $1,000,000.

The cordage works at Bath, Maine, will be rebuilt and operated by a stock company, with a capital of $65,000 to $70,000.

Case Brothers, Manchester, Conn., paper manufacturers, are extending their works—building a new boiler house, etc.

The Peru Mower Company has been incorporated, to operate at Peru, Ind. The capital stock is $50,000 in shares of $50 each.

It is rumored that the Minnesota Iron Company will establish works at Duluth or West Duluth, Minn., in the near future.

It is said that Philadelphia capitalists will commence at once the construction of a million dollar cotton factory at Montgomery, Ala.

The Wilmington (N. C.) Cotton Mills Co recently reported as to add 2,500 spindles to its mill, has decided to increase its capital stock to $150,000.

The North Brookfield (Mass.) Shoe Co. has been incorporated, with a capital of $20,000. W. H. Montague is president, and G. R. Hamant, treasurer.

The Wilson Manufacturing Company, Hamilton, Ont., has been incorporated, with a capital stock of $30,000, for the manufacture of agricultural implements.

The Union Feed-water Heater and Purifier Manufacturing Co., of Chicago, has been organized by Charles N. Hunt, C. M. Wilkinson, G. B. Field, and others.

The Pioneer Iron Works have been incorporated at Middlesborough, Ky., by William Arthur, J. W. Forrest and S. W. Ritchie, to erect foundry and machine shops.

C. A. Stevens & Co., woolen manufacturers, Ware, Mass., have plans drawn for a big addition to their woolen mill. Builders are already figuring on the work. The contract will be awarded soon.

The Mahoning Boiler Works, Youngstown, Ohio, have completed the addition to their works, 6x140 feet. They put in a new riveting machine and a Seller's crane.

Younkin, Watkins & Co. have started a foundry for general work at Williamsport, Pa. Mr. Evans, formerly of Leman, Evans & Co., is connected with the enterprise.

Of the $150,000 necessary to guarantee the building of car works at Lynchburg, Va., $95,000 have been subscribed, and the outlook for such an establishment is considered good.

The Luca Cotton Mill Co., with a capital stock of $250,000, has, it is reported, contracted for the erection of a cotton mill at Bridgeport, Ala., to be 400 feet long and two stories high.

The Riverton Land Company has been organized, to build the new town of Riverton, Ala. It will, it is stated, erect two iron furnaces and a basic steel plant, also develop iron and oil lands, etc.

The Norton & Jones Machine Tool Works, Plainville, Conn., have succeeded W. P. Norton, of Bristol. The firm build single and multiple-spindle sensitive drills as a specialty, and other fine machine tools.

S. A. Dudley, manufacturer of shuttles, Taunton, Mass., has recently patented a woolen shuttle, which has an outside catch, and which is attracting much attention among woolen manufacturers.

The United States Compress Co. has been incorporated at Louisville, Ky., by A. L. Blackman, W. S. Parker, Thomas Parkes and others, to build and operate cotton compresses. The capital stock is $10,000,000.

A contract has been entered into in New York City by the Wyoming & Pacific Improvement Company, by which $15,000,000 are to be spent in building a railroad from Sioux City to Ogden, Utah, a distance of 800 miles.

A contract has been closed with the Railroad and Improvement Co., of Florence, Ala., to locate a large foundry for the manufacture of store fronts, architectural iron castings, etc., at that place. The plant will cost $100,000.

The Salem (Va.) Silk Co. has been organized, with S. M. Schindel, of Hagerstown, Md., president, to operate a silk factory. It is intended to erect a mill to cost $75,000, and a dye house to cost $15,000. The capital stock is $240,000.

The Atlanta Car Company has been organized at Atlanta, Georgia. The company will buy a full line of wood and iron machinery for the manufacture of freight cars. Ground is now being graded, and plans drawn for buildings.

The Cleveland Wheelbarrow and Truck Company, Cleveland, Ohio, has issued a new catalogue, in which is illustrated and described some of the products of the company. Barrows and trucks for almost all conceivable purposes are made by this company.

Workmen employed by the Howland Mill Corporation at New Bedford, Mass., are busily engaged in clearing up the woods and bush north of the mill buildings. There are rumors of another mill to be built in the fall, of dimensions twice the size of the present No. 2 mill.

The Broadway (Va.) Machine Co. has organized as a stock company, with S. R. Hoover, president; G. S. Aldhizer, secretary and treasurer; S. C. Theis, manager, to increase the capacity of its works by putting in new machinery, and the erection of additional buildings. The capital will be $25,000.

The Wisconsin Lumber Company contemplates the erection of a saw-mill at Rhinelander, Wis., to cut the timber on large tracts in Oneida County and in Michigan, recently purchased from Wright & Ketchum, of Saginaw, Mich. The logs will be railed to the Wisconsin and driven to Rhinelander.

The Universal Lasting Machine Company has been organized at Portland, Maine, with a capital stock of $500,000; paid in, $31,000; par value shares, $10. President, Edwin W. Brown; treasurer, Albert F. Preston. Business to be prosecuted, manufacturing and dealing in machines for lasting boots and shoes.

The shops of the Dickson Works at Scranton, Pa., are being enlarged by the building of an extensive brass and foundry department, while the old foundry is being raised to the height of three stories. Three new cranes, two of 20 ton, and the other of 35 ton capacity, will be placed in these buildings.

The Bonham Electric Light and Power Company has increased its capital stock from $20,000 to $50,000. The object in increasing the stock $30,000 is to use that amount in the erection of a cotton-seed oil mill, whose capacity is to be thirty tons per day. This mill is to be completed and ready for business by October 18.

Preparations have been begun by Messrs. Daniell & Kidder, at Franklin Falls, N. H., for moving the machine shop and erecting an addition on the north side of the Winnipiseogee River. They will consolidate the Cate, Ryan & Co. shop with the Haynes & Kidder shop, and have one well equipped for their business.

The Findlay (Ohio) Carbon Works Company are about to erect a two-story iron building, 75x200 feet. They will also build ten kilns, to be used for the manufacture of carbon batteries, electrical appliances, porcelain cut-outs and incandescent lamps. P. C. Burns, 210 North Third street, St. Louis, Mo., is manager.

The Demorest Fashion and Sewing Machine Company, Williamsport, Pa., are building three hundred sewing machines a week, and expect to largely increase the output. In the foundry department from five to six tons of iron per day is melted. The company fills large orders in cast chair frames and school desks.

The Beldings, of Northampton, are increasing their capacity for manufacturing silk by erecting still another factory for that business. It is located, where they have other interests, at Belding, Mich., a town named for them and largely built by them. They have for years maintained one of their silk plants in Northampton, Mass.

The Thermal Electric Company, Kittery, Me., has been incorporated, with a capital stock of $125,000. It will manufacture various electrical devices, especially thermal devices and thermal cut-outs. Incorporators: Lorenzo B. Favor, Edward O. Gaffney and John Renby, Jr., all of Gloucester, Mass. Address care E. C. Spinney, Kittery, Me.

There is water-works agitation at Watertown, Wis.; Flint Village, Mass.; Milton, Mass.; Tipton, Ind.; Cadillac, Mich.; Bentonville, Ark.; Atlanta, Ga.; Schenectady, N. Y.; Marysville, Ohio; Laurens, S. C.; Gainesville, Ga.; West End, Ga.; Portsmouth, N. H.; Westport, Conn.; Brinkley, Ark.; Cape Girardeau, Mo.; Ashland, Ky.; Sheffield, Ala.

The Northwestern Electric Supply and Construction Company, of Seattle, Washington, has recently been re-incorporated under the name of the Northwestern Electric Supply and Construction Company, with a paid-up capital of $75,000. This is the pioneer company in the far Northwest, and has installed many of the electrical plants in that section.

The Vulcan Iron Works at Wilkesbarre, Pa., have on hand now one of the largest pair of first motive hoisting engines ever made. They are for the Delaware and Hudson Coal Company, and will be used at the Conyngham mine at Wilkesbarre. They are 600 horse-power, and, with an 18-foot drum will hoist a carriage up a 600-foot shaft in twelve seconds.

An English syndicate, with $2,000,000 capital, has been formed for the development of some of the rich mineral regions of North Alabama, and for building up numerous heavy enterprises. The syndicate has established its home office in London, its American office in Sheffield, Ala., and is to proceed at once. Furnaces, and mills, and factories are to be built as rapidly as possible.

The Cincinnati Edison Electric Light Company, with a capital of $1,000,000, was incorporated recently at Columbus, Ohio. The incorporators are: Samuel Emerson, J. H. Rhodes, Capt. C. M. Holloway, J. Gordon Taylor, Thomas C. Pearce and Thomas C. Smith. The company will operate in the city of Cincinnati, and reserves the right to conduct its wires overhead or under ground.

New factories are to be erected in Lansing, Mich., by two newly incorporated companies, the capital stock of which will aggregate $5,000,000. One is the Limited Fuel Gas Co., and the other the Independent Fuel Gas Co. Their purpose is to make plants for the manufacture of fuel gas by a new process. The incorporators are New York and Lansing capitalists. The headquarters will be at Lansing.

The estate of F. W. Richardson, Troy, N. Y., H. G. Hammett, manager, send us a circular of the Richardson balanced slide valve and the Allen-Richardson valve made at the works. The catalogue also contains illustrations and descriptions of relief valve and model valve motion made at the works. The Richardson balanced valve is used principally on locomotives, although many are in use on other engines.

There is a prospect that the woolen mill at West Buxton, Maine, destroyed by fire two years ago, will be rebuilt this spring. Interested parties are canvassing for stock, and nearly the required amount—$8,000—has been subscribed. J. R. Libby, of this city, a member of the dry goods firm of Manson G. Larrabee & Co., is one of the principal subscribers to the stock. The factory will be exempt from taxation for quite a term of years.

A press dispatch says: "The Thurmound Coal Company, of Thurmound, Fayette County [W. Va.], is erecting the first electric mining plant in this State. The plant completed will cost about $20,000. The mines will be supplied with electric lights and electric mining machines. The dynamos will have a capacity of 350 amperes of current, which is equal to about 94 horse-power. They are so constructed that they are perfectly safe, making accidents to human life impossible."

A new electric light franchise, running for twenty years, has been granted by the City Council of Elgin, Ill., to I. C. Towner, who will organize a company composed largely of local men, with a capital stock of $100,000. Mr. Towner owns the buildings in which the plant now operated by the Elgin City Railway Company is located. He claims that the company will be furnishing light and power before snow flies, and that both will be much cheapened by the advent of his company.

Articles of incorporation have been filed in the office of the Kansas Secretary of State by the National Car Heating Company. This corporation, whose headquarters will be in Topeka, has a paid-up capital stock of $100,000, and is officered as follows: President, N. R. Baker; secretary, I. N. Baker; treasurer, H. W. Sharp. The letters patent under which the corporation will operate were issued to J. Q. C. Searle, for the Searle steam heating and double circulation of hot water, an invention that can be utilized for houses as well as cars.

The Augusta (Ga.) Railway Company has been incorporated, with a capital stock of $300,000, and is building eight miles of double and four miles of single track. The power house will be on an excellent water site. Both steam and water power will be used. The station will consist of six Edison No. 32 compound-wound dynamos of 80,000 watt capacity; and 20 Brill cars, each equipped with two fifteen horse-power Sprague latest improved motors, will be run over the line to all the principal points in the city and suburbs, including the village of Summerville, two and one-half miles distant.

Mitchell & McClure, of Saginaw, Mich., have contracted with the West Duluth Land Company to build saw and shingle mills at Duluth, Minn., to cost about $200,000, the company donating fifty acres of land as a site. The mill will contain four band saws, and cut about 250,000 feet. Extensive dry docks and yards will be established. The company owns about 450,000,000 feet of excellent pine on the Nemadji and other streams, having bought about 365,000,000 feet the past year. A logging road will probably be built through the property to the St. Louis River. It is expected the first logs will be sawed next spring.

From Norwalk and Toledo, Ohio, two plants being consolidated, will come the Muskegon (Mich.) Machine and Foundry Co., to engage in the manufacture of sewing machines and various kinds of light machines. This company will put in a very fine and complete plant, and be prepared to take contracts for making machines of almost any kind and in almost any quantity. They already have a contract for making wire and nail machines under the Klotts' patent, and expect to do a large business in this. A leading feature will be the manufacture of sewing machines, and an electric motor to furnish power for these.

At the mouth of the main left-hand fork of the Buckhannon River, W. Va., John Alexander & Co. will build an extensive lumber manufacturing establishment—in fact, they have already commenced operations. They have a portable mill located at that point, and are making lumber to put up their buildings, and everything will be ready, by the time the railroad reaches there, to put in the heavy machinery. The company also has about 30,000 acres of land in that vicinity heavily timbered, and they will clear it of all the marketable lumber. They have large contracts with the Standard Oil Company, and will do a very extensive business, employing from 300 to 400 men when they get started in full. The timber consists of fine poplar, oak, ash and cherry, and it will be cut down and worked up as it comes. This will be the biggest plant of the kind in the State.

The foundations for the new pulp mill being built at Augusta [Maine] by the Cushnoc Fiber Co. are nearly completed, and the walls of the building will soon be rising to view. The foundations are of the most permanent kind, composed of granite blocks, and are immediately in front of Bangs Bros.' old sash and blind factory, which, when the new building is completed, will form a part of the pulp mill. The new building will present a front 125 feet long, 22 feet high at the north end, and 22 feet in depth. The south end of this front will be 40 feet in height. In this building will be the acid room, while in a building immediately back of and connected with it, 55 feet long, 22 feet wide and 44 feet high, the digesters will be located. For this building not only granite walls have been laid, but the entire space where these immense digesters are to stand is made solid by a floor, 37x12 feet, of granite blocks set in the ground to a depth of seven feet. This solid work is rendered necessary by the great weight of the digesters, each weighing twenty tons, and the strain caused by them in "blowing off." The size of the old Bangs' mill is 100x40 feet, and three stories high. The interior of this building is all to be changed, and will contain the blow-pits, screens and wet machines. The wood for the new mill will be prepared in the old pulp mill, additional machinery being put in there for that purpose. The power will also be furnished from the Augusta Pulp Co.'s building. John P. Wyman has been awarded the contract for constructing the buildings.—*Industrial Journal.*

James Nasmyth.

We referred, briefly, recently, to the death of the well-known engineer, James Nasmyth. For the following in relation to his life and work we are indebted to the *Manchester Guardian:*

We regret to announce the death, in London yesterday, of Mr. James Nasmyth, whose name is so widely known in connection with the steam hammer and other mechanical and engineering operations. In a certain sense Mr. Nasmyth was a Lancashire worthy, for although not a native he deliberately selected this county as the most suitable, from the character of its people, for his engineering works, and the fortune amassed in twenty years is a sufficient proof both of the correctness of his judgment and of his business capacity. The family of Nasmyth is an old one, and its history both originates and culminates in a hammer. One of the forefathers was fighting for James III. of Scotland in his struggle with the Douglases, and, defeated by the fortune of war, had taken refuge in a smithy, where he was passed off as a hammerman. The enemy, in search of the fugitives, entered the place, and the disguised warrior, unaccustomed to his new trade, struck a false blow, which broke the shaft in two. "Ye're *nae Smyth!*" cried a pursuer, whereupon the unskilful hammerman wrenched the dagger from his assailant, and, aided by the smith, drove off the Douglas men and converted defeat into victory. For this signal service he received a grant of lands and a grant of arms. On the Nasmyth shield may be seen "a hand dexter between two broken hammer shafts," and the motto *Non arte sed marte.* But the later generations of the Nasmyths have won their triumphs, in contradiction of this martial motto, not by war, but by the arts of peace. Nasmyth, the engineer, was the son of Alexander Nasmyth, the painter, who, in turn, was the descendant of several generations of architects and builders. The boy's early years were passed in Edinburgh, where he was born in 1808, and where his father was known and appreciated by the best of the remarkably intellectual set who then gave distinction to the Scottish capital—amongst them Burns, Scott, Lockhart, Brewster, Wilson, and others. The painter had also a strong taste for mechanics, and was the author of the "Sunday rivet" and other important contrivances. His workshop was the primary school of James Nasmyth. The boy did not take kindly to the methods of education then in vogue, but at the High School he became acquainted with the sons of a large iron founder and of a practical chemist, and took great delight in these works. Under his father's care he had become a skillful draftsman. Part of the cost of his courses at the Edinburgh University were defrayed by the construction of models of steam engines. His mother would sometimes peep into his little workshop and say, "Ye'll kill yersel, laddie, by working so hard and so late." The whole family were most affectionate and devoted to each other. He conceived what amounted to a passion to be employed at Maudslay's, but when father and son arrived the great engineer said he would have no more pupil apprentices.

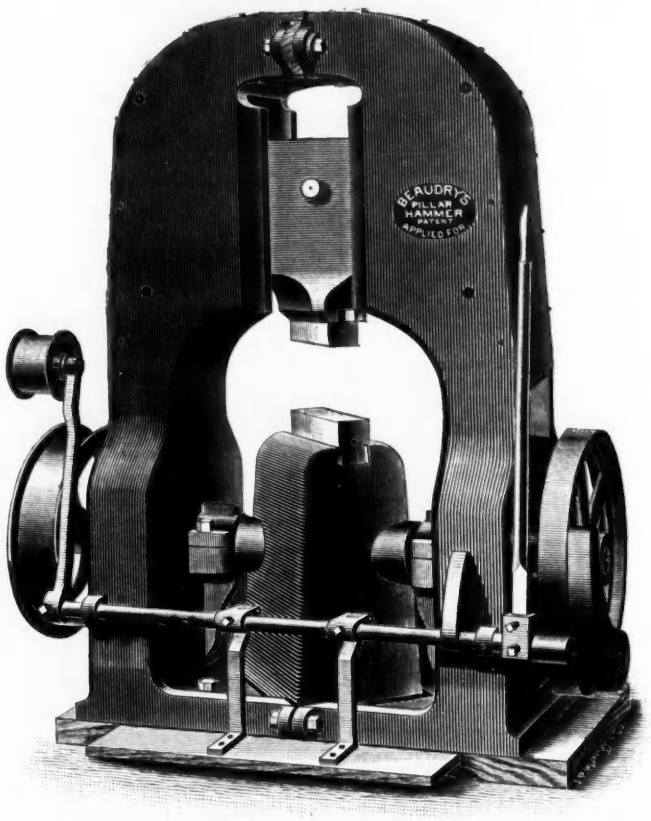
As he took them through the works they passed a laborer clearing out ashes from under a boiler furnace, and the young Nasmyth said, "If you would only permit me to do such a job as that in your service I should consider myself most fortunate." "So," said Maudslay, "you are one of that sort, are you?" He became assistant in Maudslay's private workshop, and continued with him until his death. In London he had the good will of many who were glad to be kind to the boy for his father's sake. Thus, Brougham introduced him to Faraday, with whom he maintained a lifelong friendship. He decided to begin business on his own account in Manchester. He was introduced to the Grants, who invited him to dinner. William Grant inquired as to his prospects. "I told him, as briefly as I could, that I intended to begin the business of a mechanical engineer on a very moderate scale, and that I had been looking out for premises wherein to commence operations. He seemed interested, and asked more questions. I related to him my little history, and told him of my desires, hopes, and aspirations. 'What was my age?' 'Twenty-six.' 'That is a very young age to which to begin business on your own account.' 'Yes; but I have plenty of work in me, and I am very ecomomical.' Then he pressed his questions home. 'But what is your capital?' I told him that my capital in cash was £63. 'What!' he said, 'that will do very little for you when Saturday nights come round.' 'That's true,' I answered; 'but as there will be only myself and Archy Torry to provide for, I think I can manage to get along very well until profitable work comes in.' He whispered to me to 'keep my heart up!' With such views, he said, I was sure to do well. And if, he added, on any Saturday night I wanted money to pay wages or other expenses, I would find a credit for £500 at three per cent. at his office

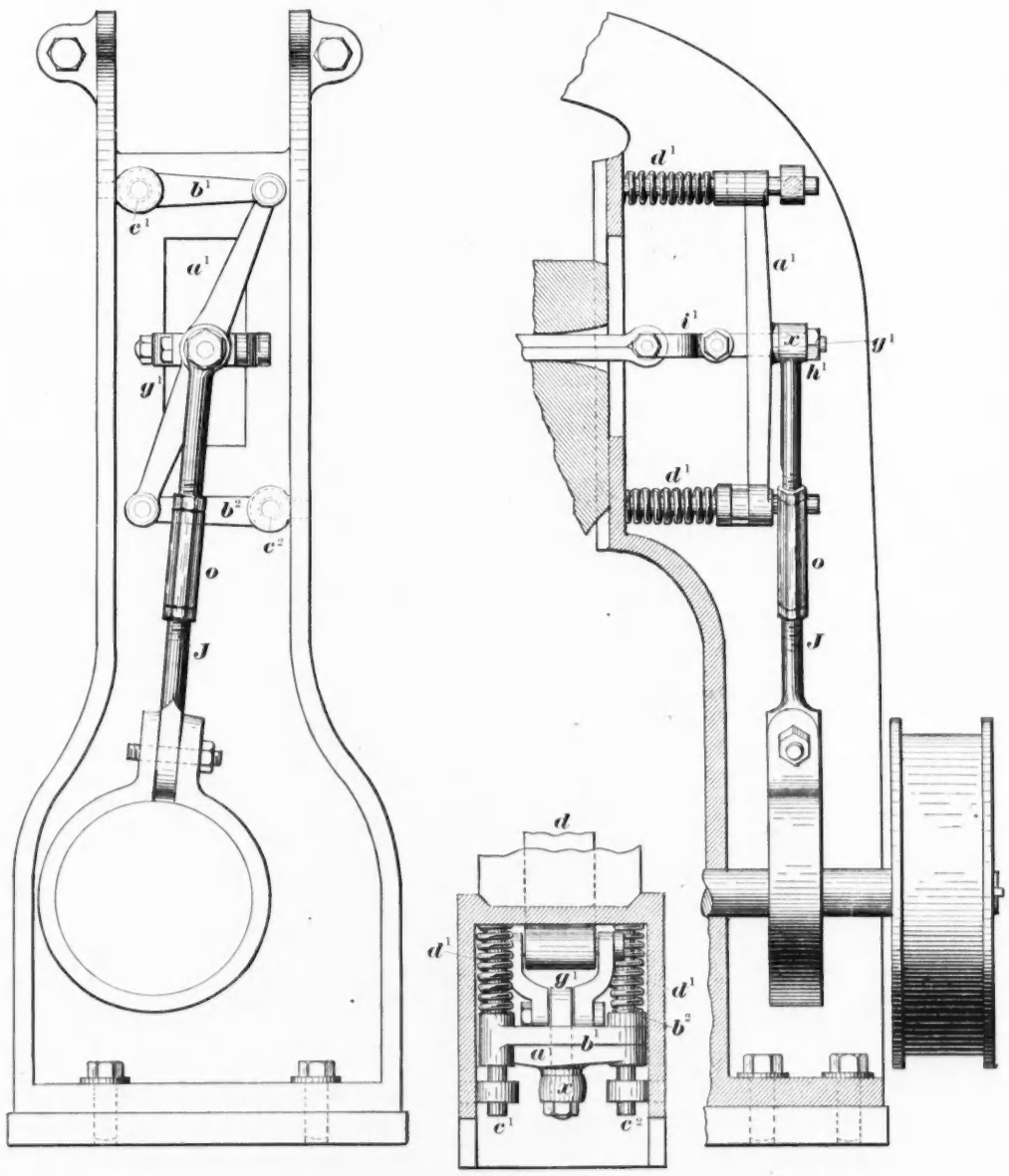
in Cannon street, 'and no security.' These were his very words." Mr. Nasmyth's experiences of this district and its people were pleasant. "On the whole," he said, "I have found a great deal of unselfish kindness among my fellow-beings. They have often turned out of their way to do me a service; and I can never be too grateful for the unwearied kindness, civility, and generosity of the friends I encountered during my stay in Lancashire." He began business as an engineer on a flat in Dale street, and his work prospered and increased until he obtained on a 999 years' lease the land at Patricroft where he built the Bridgewater Foundry. This was the birthplace of the steam hammer. Into the controversy as to its origin we need not enter. The most remarkable application of the hammer in its earlier days was for driving the piles for the extension of Devonport Docks. "There was a great deal of curi osity in the dockyard as to the action of the new machine," says Mr. Nasmyth. "The pile-driving machine men gave me a good-natured challenge to vie with them in driving down a pile. They adopted the old method, while I adopted the new one. The resident managers sought out two great pile logs of equal size and length—70 feet long and 18 inches square. At a given signal we started together. I let in the steam, and the hammer at once began to work. The four-ton block showered down blows at the rate of eighty a minute; and in the course of four and a half minutes my pile was driven down to its required depth. The men working at the ordinary machine had only begun to drive. It took them upwards of twelve hours to complete the driving of their pile." A round of cheers greeted this performance of the steam giant.

In the management of his Patricroft works Mr. Nasmyth showed genuine interest in the welfare of his workmen, but he was strongly opposed to unionism, and successfully defeated a strike by the importation of new hands. "Free trade in ability" was one of his mottoes. Mr. Edward Tootal early in his business career said to him, "Never give your men cause to look over the hedge," and by following this excellent advice, which was fully in accordance with his own generous disposition, he made his men comfortable, and therefore loyal. In 1856 Mr. Nasmyth retired from business life, at the early age of 48. He had been happily married for sixteen years, and on leaving Patricroft invested the bulk of his fortune in consols, which his wife happily described as "the true antibilious stock." Since then in his pleasant retreat at Penshurst he has devoted himself chiefly to the study of astronomy, and is the discoverer of the "willow leaf" appearances on the surface of the sun. In 1874 he published an important monograph on the moon, and in 1883, a charming "autobiography," which was edited by Dr. Smiles, and indeed grew out of suggestions and inquiries made by the author of the "Lives of the Engineers." In this volume he not only tells the story of his own early struggles, but pays a filial tribute to his father's genius. The list of Mr. Nasmyth's mechanical inventions is a long one. His name will be remembered both in pure and in applied science, whilst the story of his successful career, his conquest of difficulties, and his progress from scanty means to well-earned leisure and ample competence, will remain as an incentive to others to emulate his example. Mr. Nasmyth had had remarkably good health, but for the last few months he had been suffering from illness, and his death is ascribed simply to old age. He left his residence at Penshurst, near Tunbridge Wells, about a month ago, and had since been staying at Bailey's Hotel, South Kensington, where he died yesterday.

A Girl Engineer.

A very pretty young lady sat in the office of the United States inspectors of steam vessels yesterday forenoon. She was handsomely dressed in black silk, wore a becoming tongue and a smile which carried the veteran inspector, Andrew Burnham, back 100 years or more to the days of his youth. Major Copeland, the genial clerk of the board, in his anxiety to do honor to his illustrious visitor, swallowed an extra clove and nearly strangled. The lady was present on business, and that business was the procuring of a license as a pilot for the steam yacht Isis. Captain Burnham was willing, if she knew her "biz," but he first sent her to the surgeon's office in the custom house to be examined for color blindness. Of course she passed. She then returned to the inspector's office for examination as to her fitness to hold the position of pilot of steam yachts. She knew all about port and starboard, cross signals, rules of the road, etc., and was given a special license as pilot of the good steam yacht Isis. The blank filled out by the United States surveyor gives the following description of Mrs. Poole, the first woman ever licensed by the board of steam vessel inspectors on the New England coast: "Name of pilot, Eliza E. Poole; age, 28 years; nativity, Massachusetts; complexion, light; height, five feet two three-quarter inches; color of eyes, blue; color of hair, brown." In her application Mrs. Poole states that she has had two years' experience on the steam yacht Nelly. "She is a dandy," says Major Copeland, as he handed her a license, filled out with more than usual care.—*Boston Herald.*





BEAUDRY'S POWER HAMMER.

New Power Hammer.

We give herewith perspective and sectional views of a power hammer recently brought out by Beaudry & Co., of Boston, Mass., the construction of which embodies some entirely new features in such machines.

As will be seen, the frame of the hammer is of such form as to secure the greatest possible rigidity and strength, motion for the hammer being taken by belt to the shaft, which passes through the base from side to side, the hole cored through the anvil block being of sufficient size to clear the shaft. The anvil block is separate from the main frame and rests upon a separate foundation, thus relieving the machine of all shocks produced by the hammer.

Reference to the detail cut will show how motion is taken from the shaft to the hammer, one side only being shown, the other side being identical with it. Eccentrics are fastened to the shaft at either side within the uprights, from which rods run up to the connection, and operate the parallel motion composed of the bar a^1, and lever arms b^1 and b^2. To the middle of the bar a^1 is also attached by a suitable link the heavy piece of leather belting which passes through the hammer and is suspended from either side, this being the medium through which motion is imparted to the hammer.

The vertical motion of the connection is 12 inches, and when the hammer is moved slowly downwards to the lowest point it does not quite reach the anvil, but when in rapid motion the deflection of the leather strap and of the spiral springs, which are seen behind the lever arms b^1 b^2, allows the hammer to come down with full force, and then raises it again very quickly, its upward limit of motion being also considerably higher than when the motion is slow. The rapidity of motion and force of the blows are under the absolute control of the operator, who regulates the machine by a foot lever, or it may be controlled by an assistant handling the vertical lever shown, this lever resting in a socket from which it may be lifted when not in use. A counterbalance in the fly-wheel stops the hammer always at the highest point in the stroke.

The machine shown has a hammer weighing 200 pounds, and will strike a blow from the lightest ever required up to 800 pounds; the full range of force being obtainable from one blow to the succeeding one, or, in other words, the first blow may be the lightest, and the next one the heaviest. The driving pulley is 18 inches diameter for a 5-inch belt; the shaft is 3 inches diameter; anvil block 28 inches high. The machine illustrated weighs 5,500 to 6,000 pounds; and other sizes are made smaller and larger than this, having hammers weighing 100 to 400 pounds, and adapted to any work within their range requiring a power hammer.

The elevated railroads of Brooklyn are advertised for sale to satisfy arrearages of taxes amounting to more than a half million of dollars. Moral: Pay as you go.

The address of the American Society of Mechanical Engineers has been changed to 12 West Thirty-first street, New York.

Extension Fronts for Locomotives.

Various smoke-stacks and spark arresters for locomotives have been designed, but have failed to accomplish the purpose of preventing sparks from setting fire to objects along the line of the road, injuring the rolling stock and annoying the passengers. Among the various devices the extended smoke-boxes, or extension fronts, as they are often called, were brought out. At first they were not as favorably received as they deserved to be; they were tried several times and then abandoned, but in late years their valuable features have been recognized, and extension fronts are now extensively used in different sections of this country. They undoubtedly have their enemies, but they have many more friends. That a few sparks will occasionally fly out of the stack on an extension front is true, and cannot be prevented so long as an opening for the escape of gases is required: but it is also true that the extension front retains the largest bulk of the sparks, cinders, and unconsumed fuel, and carries them to a place where they can do no harm, instead of throwing them along the line of the road—the worst use they can be put to. The extra expense incurred for emptying the boxes at designated places should not be an objection, as it certainly amounts to much less than the compensations paid for fires so often caused by the use of other devices.

In order to make the extension fronts work successfully, they must be fitted perfectly air-tight, otherwise the cinders will catch fire, warp the sheets, and render the box useless. Neither should they be allowed to fill up too much, as then the sparks will be thrown out of the stack; also ample means should be provided for emptying the smoke-boxes without opening the door in the front.

Although the primary object of the extension fronts is to retain the sparks, it is often claimed that they save fuel; we believe that this claim could be substantiated by carefully conducted experiments. The strong blast in the short smoke-box not only draws the sparks, but also unconsumed fuel into the smoke-box; and since there is no room in the short boxes to hold them, they have to be lifted bodily and thrown out of the stack, and this means an expenditure of work which the exhaust steam must supply. Again, this solid matter meets obstructions in the smoke-stack, such as the netting, cones, etc., against which it is violently thrown and broken up; this also requires work which must be furnished by the exhaust steam. Even the fact alone of having obstructions to the passage of the exhaust steam must necessarily reduce the useful effect of the blast. Now the extension front has generally a plain smoke-stack without any obstruction in it; the exhaust nozzles extend to above the netting in the smoke-box, hence the exhaust steam has an unobstructed passage, and will on this account lose little of its useful effect.

The cinders are held in the box, hence there is no work expended in lifting these and throwing them out of the stack; no work is required from the exhaust to break them up, hence it is reasonable to conclude that the exhaust steam in the extension front has less work to do than in the short box, and that in the extension front nearly the whole force of the exhaust steam is expended for its legitimate purpose, namely, creating the necessary forced draught. It is also reasonable to conclude that, since the exhaust steam has less work to do, the exhaust nozzle can be made, and, in fact, is made larger in the extension front than in the short smoke box. But enlarging the exhaust nozzle leads to other consequences—it reduces the back-pressure in the cylinders, and creates a milder draught so that lighter fires can be carried, and more time given to combustion. In view of all these advantages we believe the claim of economy in fuel to be just.

But there is a possibility of over-estimating the economy of fuel with the use of the extension front. In the majority of cases a brick arch in the fire-box is used in connection with the extension front; the brick arch tends to prevent unconsumed fuel from being drawn into the smoke-box, which also tends to save fuel, and the amount saved by the brick arch and that saved by the extension front can only be determined by carefully conducted experiments.

That extension fronts have not given satisfaction in some cases cannot be denied, but we believe the cause to have been bad workmanship, faulty design, or want of proper care when in operation. On the other hand, many of our prominent roads are using them successfully, and there are no signs of abandoning them.

It is sometimes stated that the great capacity of the extension front is detrimental to the draught. Mr. D. K. Clark, in his treatise on Railway Machinery, recommends three cubic feet of capacity per square foot grate surface as the proper proportion for a smoke-box. Many extension fronts do not contain much more than that when empty, and when partly filled will probably contain less, hence not much trouble need be anticipated from the increased capacity.

Besides the advantages named, the use of the extension front also promotes the comfort of passengers, and cleanliness. The passengers may keep the windows open with comparative comfort, and are not so liable to soil their hands in taking hold of hand-rails when stepping off the car.

Wooden Horses.

O. S. Whitmore, writing to the *Northwestern Lumberman*, has, amongst other things, this to say about horses—wooden horses used in the building trades.

The life of a horse is short, averaging about one-half the ordinary building season, and in many cases only one-third. If the average contractor were asked as to the number of horses in use in Chicago at a given time, he would probably answer, "I don't know." Or if he undertook to tell, would not come within many thousands of the right number. Were he asked as to the actual number used in a year, his guess would undoubtedly be wilder still. The writer has haunted stone masons, brick layers, plasterers and lathers, till he can present the following as being somewhere near the truth. If there is any error it is in not making the figures large enough.

A horse will average about 30 feet of lumber, and there are about 50,000 horses in use in the city to-day; double this for the season, and we have a total of 3,000,000 feet of lumber every year put into these awkward but useful and indispensable adjuncts of the building trade. A prominent contractor gives the cost of his horses as all the way from 60 to 75 cents each. He also asserts that it is a pretty small contractor who does not use fully 100. This would make the estimate of the number here given much too small, but for the further fact, as he states it, that many of the lesser concerns, who work only on small dwellings, and other small jobs, make their horses last longer than here stated.

There are no regular manufactories of horses here in the city, as far as the writer could discover, but the carpenters make them by the piece for the masons and plasterers, and evidently make a good thing of it. Why no one has thought to start a shop with a little outfit of suitable machinery, is a wonder. A better and cheaper horse could be made, and there is a pretty good chance for a business that involves the use of from 2,500,000 to 3,000,000 feet of lumber annually, or a business of upward of $50,000. Many of the contractors have expressed the wish that there was such a concern, where they could send any time and get just what they want, and at a reasonable price. Who will make the venture?

The ninth annual convention of the New England Water-works Association will be held at Portland, Maine, on June 11, 12 and 13. Arrangements have been made for the accommodation of delegates and guests at the several hotels in the city. There will be the usual reading of papers, and an exhibition of water-works supplies.

The London & Northwestern Railway Company proposes to invest two and a half million dollars in improving Holyhead harbor, so as to make the landing of transatlantic steamers safe and pleasant. If this is done it will shorten the time between New York and London by ten hours.

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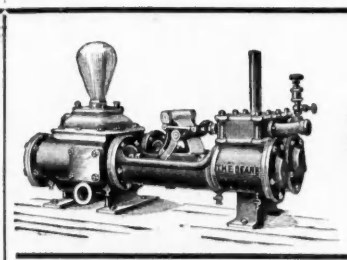
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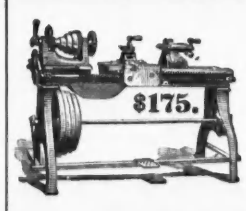

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Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.
CAN BE FORCED HOT.
Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Ingot metal for car and engine bearings. Spring wire.
ANSONIA BRASS & COPPER CO.,
Sole Manufacturers.
Send for Circular. CHICAGO. NEW YORK.

BETTS MACHINE COMPANY,
WILMINGTON, DEL.,
MAKERS OF
METAL-WORKING MACHINE TOOLS
FOR
Locomotive, Bridge and Engine Builders, Railroad, Car and Machine Shops
AND
Iron and Steel Works Generally.

In accordance with a resolution adopted by the A. S. M. E., President Smith appointed the following members as a committee to report at the next meeting upon a standard method of tests for locomotives: Charles B. Richards, William Forsyth, Henry B. Stone, Prof. James E. Denton, Francis W. Dean, Axel S. Vogt, and Allan Stirling.

By some unaccountable mistake, this committee was referred to last week in our report as a committee to investigate and report upon the comparative efficiency of compound and simple locomotives, a misstatement which we take this opportunity to correct.

The committee on nominations for officers is as follows: Robert W. Hunt, Henry G. Morris, B. H. Warren, G. A. Gray, and Jesse M. Smith.

A well-known locomotive engineer declares that if he could invent a red paint that would withstand the action of the fire, he would have no difficulty—by painting the inside of fire-boxes with it—in getting certificates of a saving of twenty-five per cent. in fuel.

In the Italian Navy experiments are being made with a mixture of coal and petroleum for fuel. A fierce fire is said to be the result, with damage to furnace plates.

Machinists' Supplies and Iron.

NEW YORK, May 24, 1890.

Iron—American Pig.—No change of importance has taken place in the situation here, though a more hopeful feeling seems to prevail in some quarters—especially in the West. Though it is probable that the consumption of iron was never greater than at present, the productive capacity of the furnaces has kept well ahead of it, and there is sufficient surplus to prevent any rise in values, with the prospect that they may be lower before the summer is over.

We quote Northern brands No. 1 Foundry, $18 to $19; No. 2, $17 to $17.50. Southern brands No. 1, $16.50 to $17; No. 2, $16 to $16.25.

Scotch Pig.—There has been no quotable change in values.

We quote Eglinton, $18.50 to $19; Dalmellington, $21.25 to $21.50; Coltness, $24.50 to $25.

Bar—The demand has been fair, with some shading of prices, though they are not quotably lower.

We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2, for round lots on dock.

Copper—The market has ruled firm, and some large consumers have recently contracted for their supplies.

We quote Ingot, Cakes and Wire Bars at 14⅜c. to 14½c. Common casting brands are somewhat easier, at 12⅜c. to 12½c.

Lead—Dealers and consumers have been doing as little business as possible, the market being almost entirely under speculative influences. Prices range from 4.20c. to 4.35c.

Spelter—Moderate sales are reported, and the market has ruled quiet.

We quote Ordinary brands of Western, 5.10c. to 5.25c.; Choice, 5⅜c. to 5.40c.; Refined, 6¾c. to 7c.; Silesian, 6⅝c. to 6¾c.

Tin—The market has been under the control of speculative influences, with a moderate jobbing demand at 21.10c. to 21.20c.

Antimony—There has been a moderate jobbing demand, quotations being for Hallett's, 19c. to 19¼c.; Cookson's, 25c. to 26c.

Lard Oil—The ruling price is 53c. for Prime, though some concessions are obtained by buyers.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Mech. draftsman wishes situation. D., AM. MACH.

Wanted—Good pushing foundry foreman; jobbing shop. Give refs. Address BOX 22, AM. MACHINIST.

Wanted—Ass't draftsman for a machine shop in Brooklyn, N. Y. Address K, AMERICAN MACHINIST.

A mechanical engineer, sup't of large works for years, wants position. Engines, boilers, sugar and general machinery. BOX 20, AMERICAN MACHINIST.

Wanted—Good general machinist to work on Corliss engines, ice and refrigerating machinery. Address Frick Company, Waynesboro. Franklin Co., Pa.

Wanted—Capable foreman for job iron foundry in Conn. State experience, and salary expected. Address Mach'y Castings, AMERICAN MACHINIST.

Wanted—A first-class pattern maker. Steady work and good pay to the right man. Address Box 16, AMERICAN MACHINIST.

Wanted—Capable draftsman; one acquainted with printing presses preferred. State exp., and wages expected. Address H., AM. MACHINIST.

Three good draftsmen wanted at once on general machinery. Give references, and salary expected. Bucyrus Steam Shovel and Dredge Co., Bucyrus, O.

Foreman wanted to take charge of a machine shop; competent to manage men, and exp'd in steam engine building. Address N. M., AMERICAN MACHINIST.

Wanted—Salesman to solicit for brass foundry; one who has other line preferred. Must have exp. Address, stating terms, etc., C., AM. MACHINIST.

Wanted—A first-class shafting turner to work on a regular shafting lathe. Steady employment in St. Louis, Mo. Address Box 18, AMERICAN MACHINIST.

Wanted—A steady position by an exp'd milling machine hand in wood-working machinery. Address W. T. V., Box 288, Galt, Ontario, Canada.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Machinists Wanted—First-class vise and lathe hands on punching machinery and machine tools; also pattern maker. Steady job and good pay. W. Frech Machine Works, Streator, Ill.

Draftsman Wanted—Presses, dies and general machinery. Write, stating age, where last employed, and salary expected, to the Dover Machine Works, Dover, Delaware.

Wanted—A foreman boiler maker for a first-class establishment on the Pacific coast. He must thoroughly understand marine and stationary boilers; also repairing. Apply, by letter only, to Boilers, AMERICAN MACHINIST.

Wanted—10 or 12 good machinists, principally vise hands. Only those familiar with the erecting of wood-working machinery need apply. This will be a good opening for ambitious young men. Address E. & B. Holmes, 59 Chicago st., Buffalo, N. Y.

Wanted—A thoroughly practical foundryman, with some capital, to join the advertiser in establishing a general iron foundry in a southern city. Must furnish satisfactory reference. Address "Foundryman," P. O. Box 1592, Philadelphia.

Wanted—Position as sup't or foreman by a young man, 35, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men. A draftsman and designer of automatic and interchangeable machinery, tools, jigs, etc. Box 14, AMERICAN MACHINIST.

Wanted—Experienced and accurate bookkeeper by Chicago firm manufacturing special machinery. Must be perfectly familiar with the business, and accustomed to figure cost of labor, material, etc., as required in building machinery. A good, permanent position to the right man. Reply, with references, stating age, experience, and salary expected. Box 21, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d-h'd Lathes & Drills. S. M. York, Clev'd, O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Wanted—Customers for our new Radial Drills C. H. Baush & Sons, Holyoke, Mass.

For Sale—Patent right of Calipers. Address E. V. Faucett, 14 E. 7th St., Wilmington, Del.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Simonsen-Walter Mfg. Co., Jefferson City, Mo., with modern foundry, machine and wood-work plant, wants spec. to manuf. for Western trade.

For Sale—Crosby Steam Engine Indicator. Having changed business, will sell cheap. Kimball Bros., Anamosa, Iowa.

Wanted—A large boring bar, 12 ft. long, with sliding and facing heads; the latter to reach 4 ft. in diameter. Rand Drill Co., North Tarrytown, N. Y.

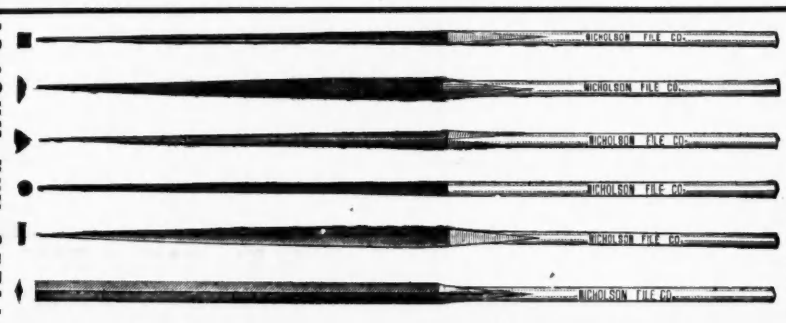
Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

For Sale—The patent on a hand-shaper, especially adapted for tool makers, experimental work or small machine work. Description of shaper with wood cut, on application to John F. Seidel, 176 William st., Newark, N. J.

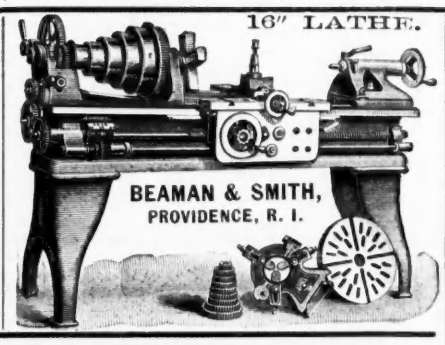
For Sale—A splendid foundry and machine shop plant (partially destroyed by fire); a great opportunity for a good party; suited for any kind of mfg. business. Good location; good R. R. facilities; very cheap. Address L. W. Shafer, York, Pa.

FILES and RASPS.



PROVIDENCE, R. I., U. S. A.

16" LATHE.



C. W. LE COUNT,
South Norwalk, Conn.

REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.75
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.95
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$23.60
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

This Dog has a Very Heavy Foss, so that if the thread wears a Heavier Screw can be substituted.

When ordering, state as above, whether a full set or a set of 12, or small set of 8. Users of these dogs prefer them to any other make.

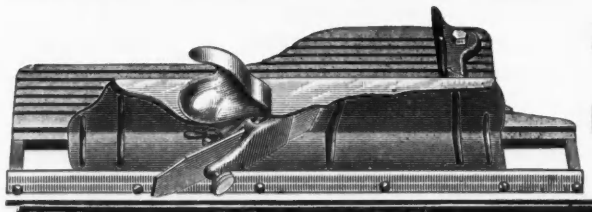
Le Count's Heavy Steel Dog.
With Steel Screw. Lathe Made and Hardened.

One Small Set of 8—by 1-4 inches to 20 inch, - - $ 6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-2 in. to 4 in 13 2

BUFFALO BLOWERS.
BUFFALO FORGE CO., BUFFALO, N. Y.

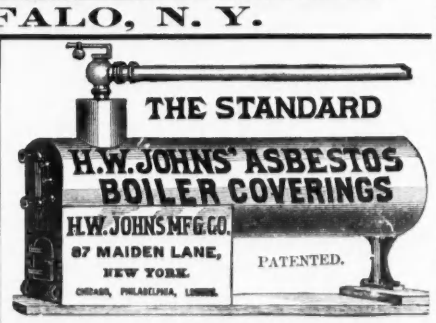
JUST PUBLISHED.
1 Vol. 12mo., cloth, $1.50.
SLIDE VALVE GEARS.
AN EXPLANATION OF THE ACTION AND CONSTRUCTION OF PLAIN AND CUT-OFF SLIDE VALVES.
BY
FREDERIC A. HALSEY,
MECHANICAL ENGINEER.
FULLY ILLUSTRATED.
ANALYSIS BY THE BILGRIM DIAGRAM
D. VAN NOSTRAND COMPANY,
23 Murray and 27 Warren Sts., New York.
Copies sent by mail on receipt of price.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



A. J. WILKINSON & CO.
Box 3600.
BOSTON, MASS.
SEND FOR CIRCULAR.

THE STANDARD



ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

Fitchburg Machine Works,
MANUFACTURERS OF
METAL WORKING MACHINERY
Nos. 13 to 21 Main St., Fitchburg, Mass.

Dodge Independence
Wood Split Pulleys.
Lighter than Iron.
Greater traction than Iron.
Bushing system allows each pulley to be fitted to 22 sizes of shafts.
COOKE & CO., Sales Agents,
22 Cortlandt St., New York.
Shafting, Hangers, Engines, Boilers, Etc.
Write for prices, mentioning this paper.

THE BRITISH & EUROPEAN PATENT AGENCY,
F. W. BARKER, Manager,
(Registered English Patent Agent According to Act of Parliament,)
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European Patents obtained at low rates and sold on Commission through London House. *A good invention is worth as much in Great Britain as in the United States.* Competent draftsmen employed on the premises, and special terms allowed inventors also obtaining their U. S. patents through the Agency. (CORRESPONDENCE SOLICITED.)

WILLIAM JESSOP & SONS, L'D.
MANUFACTORY, SHEFFIELD, ENGLAND.
Chief American Office, 91 JOHN ST., NEW YORK.
JESSOP'S BEST TOOL STEEL
Gold Medal, Paris, 1889.
Importation Orders Promptly filled.
ALL KINDS OF Steel in Stock.

A FACT FOR YOU.
A large manufacturing firm, who has neglected the adoption of a Berryman Feed Water Heater and Purifier in their steam plant, were at last, owing to the cost of fuel, induced to put one in.
In less than a month they found a saving of over 30 tons of coal. This not only showed a great interest on the investment, but in a few months paid the whole cost of the heater.
BENJ. F. KELLEY & SON,
91 Liberty St., NEW YORK.
SPECIALISTS IN
Feed Water Heating & Purifying.

WORTHINGTON
Independent Condenser
An Economical Addition to Steam Engines.
POWER GAINED or FUEL SAVED
AND
BOILER PRESSURE LOWERED
ESPECIALLY RECOMMENDED FOR
ELECTRIC LIGHT MILL BOAT and PUMPING ENGINES
HENRY R WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA CHICAGO
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Established in 1874.

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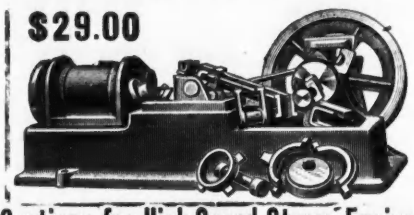
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.



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Castings for High Speed Steam Engine.

CYLINDER, 4 in. x 4 1-4 in.

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Sets of Castings for Engine illustrated above, with *Cast-steel Shaft, Connecting Rod* and *Rock Shaft* and *Brass Bearings*, boxed and shipped on receipt of $29.00. Three sheets *blue prints* of working drawings, extra.

GLEASON MACHINE TOOLS

Engine Lathes, 22 inch to 72 inch swing.
Iron Planers, 26 inch to 84 inch wide.

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BEST SYSTEM on Earth for PUNCHING IRON AND STEEL.

BEVEL GEAR CUTTERS, GEAR CUTTERS
FOR
SPECIAL JOBS, DIAMETRAL, CIRCULAR & ODD PITCHES.

Special and large Diameters. Special size Holes. All made to sharpen. Facilities for prompt delivery.

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STEAM **PARK** Double Jet **INJECTOR**

PARK MFG. CO.,
53 Portland Street,
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THE most reliable under varying steam pressure of any injector known. Will work from 15 pounds to 180 pounds without any adjustment. The only **Automatic Injector** that will thoroughly drain itself when shut off, thus preventing freezing. *Every Machine Guaranteed.*

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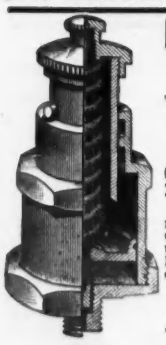

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Will Save its Cost in Oil alone Several Times per Annum.

SAVES ALSO IN LABOR AND COST OF COTTON-WASTE, PREVENTS DRIPPING AND SPATTERING.

A POSITIVE FORCE FEED with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position.

Lackawanna Lubricating Co.,
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SOME NOTABLE ARTICLES

APPEARING IN BACK ISSUES
OF THE

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The following list is published to facilitate the ordering of back numbers containing them. Any of these issues can be ordered through any newsdealer, or of the publishers direct, at the price then ruling, viz.: 5 Cents a Copy.

1886.

Pattern Making, Various Articles on. By F. W. Barrows. Appearing in 29 issues.
Foundry Practice, Various Articles on. By Robt. E. Masters, appearing in 16 issues.
Strength of Different Mixtures of Cast-iron and Method of Testing. By Robt. E. Masters, April 24.
Foundry Practice, Articles on. By Foundryman. [L. C. Jewett.] Aug. 14, Sept. 25, Dec 18.
Foundry Practice, Articles on. By S. Bolland, May 8, 22 29, June 26, July 10.
The Morton-Poole Roll Grinding Lathe. By Joshua Rose, J. G. Tramis, Geo. H. Babcock and C. A. Smith, July 3, 24, Aug. 7, 14, 21, Sept. 25.
Machine Shop Cost and Time Accounts. By A. J. Shaw, Henry Metcalfe and C. A. Burton, April 3, 17, May 8.
Tests of Iron. By David Spence, April 17, Oct. 30.
Traction on Grades. By A. B. Ropes, Oct. 30.
Wilson's Valve Gear for Locomotives, Oct. 30.
Casting Face-plates Face Up. By David Spence, Oct. 23.
A Job of Shaft Straightening. By F. L. Johnson, Oct. 23.
Inventory Valuation of Machinery Plant. By Oberlin Smith, Aug. 7.
Making a Cast-iron Sheave. By P. S. Dingey, July 31.
New Dredge Boiler designed by Norman Wheeler, July 17.
Core Oven with Rotating Back. By Thos. Wathey, July 24.
Universal Table for Lathe Change Gears for Screw Cutting. By Joshua Rose, July 24.
Gating, Clamping and Securing Chaplets. By Matthew Wiard, May 1.
Printing Frame and Manner of Making Blue Prints. By C. L. Redfield, July 31.
Some Pressure Tests. By C. O. Sine, Nov. 27.
An Expanding Mandrel—Turning Tapers. By Chas. S. Beach, Nov. 27.
Core Making in Foundries. By David Spence, Nov. 20.
Making Pattern for Spiral Grooved Drum. By Geo. Allge, Aug. 14.
Rolling Conic Sections Applied to Gears. By Geo. B. Grant, Nov. 6.
Ninety-inch Belpaire Fire-box Boiler, Nov. 6.
Spacing in the Milling Machine. By Chas. S. Beach, Aug. 21.
Engine Crossheads. By J. G. Tramis, Aug. 21.
Traction and Adhesion. By A. B. Ropes, Aug. 28.
Internal Key-seating on Milling Machines. By A. B. Landis, April 17.
Tapping Holes in Boilers. By A. B. Landis, April 24.
How to True Emery Wheels. By L. Best, April 24.
Work and System in the Drawing-room. By C. L. Redfield, Aug. 28.
Oiling Lathe Carriage Ways. By Wm. H. Bradt, Aug. 28.
Moulding a Screw or Worm without Cores. By George Allge, Sept. 11, 18.
Power Absorbed in Cutting Cast-iron. By James F. Hobart, Sept. 11, 18.
Moulding Screw Propellers in Loam. By Chas. A. Devlin, Sept. 18.
Dimensions of Wrought iron Pipes in England. By A. G. Brown, Sept 4.
Truing Up and Replacing Milling Machine Centers with Accurate Alignment. By A. B. Landis, Jan. 16.
Methods of Working and Tempering Steel. By S. W. Goodyear, Jan. 9.
Slotting Tool. By J. J. Bingley, May 8.
How to Make Clean Solid Castings at Least Possible Cost. By Matthew Wiard, April 10.
Truing Milling Machine Centers. By W. R. Ballou, April 10.
Lining Engine Lathes. By Chas. S. Beach, April 10.
Steam Piping. By J. G. Tramis, April 10.
An Equalizing Dog. By A. B. Landis, April 10.
Screw Cutting Dies. By John J. Grant, April 10.
Some Handy Shop Tools. By Fred. H. Colvin, April 3.
Moulding Bells for Blast Furnaces in Green Sand Without Patterns. By Geo. O. Vair, April 3.
Furnace for Heating Long Bars. By W. G. Richards, April 3.
Cutting Tools—Roll Turning. By S. W. Goodyear. Oct. 16.
Hydraulic Forging. By J. Richards, July 10.
A "Box" Jig. By C. E. Simonds, June 19.
Cheap Testing Machine. By Wm. Merrill, Feb. 6.
Boring Deep Holes. By A. B. Landis, Mar. 27. May 8.
Working Steel and Iron. By S. W. Goodyear, Feb. 13.
Inventory Valuations of Patterns. By W. E. Matheson and others, Jan. 9, Feb. 13, 20, Mar. 6.
Making Cast-iron Half Boxes. By A. J. Shaw, Feb. 6.
Draining Steam Pipes. By W. E. Crane, Feb. 6.
Brazing and Welding Iron. By J. F. Hobart, Mar. 6.
Deep Holes by Continuous Boring. By A. B. Landis, Mar. 27.
Slotting Machine Tool. By Wm. Foster, Mar. 20.
Compound Engines for Stationary or Factory Purposes. By W. H. Hoffman, April 24, May 1, 22.
Engineering Subjects, Articles on. By W. H. Hoffman, Mar. 13, July 24, 31, Aug. 21, Oct. 9.
Self-contained Engines. By W. H. Hoffman, Feb. 27, Mar. 6.
Curving Qualities of Locomotives with High and Low Centers of Gravity, Oct. 16.
Making Large Spur Gear Wheels. By P. S. Dingey, Oct. 2.
Normal Theory of the Gear Tooth Curve. By Geo. B. Grant, Mar 13, 20, Oct. 9.
Return Tubular Boilers. By Wm. Lowe, Nov. 27, Dec. 4.
Chimneys for Steam Boilers. By Wm. Lowe, Mar. 27, May 15. By F. A. Halsey, May 1.
Railroad Cost Cards and Expense Sheets, April 24.
The Milling Machine—Its Construction and Uses. By John J. Grant, Mar. 20.
Mechanical Arrangements of the N. Hudson County Cable Railway, Mar. 20.

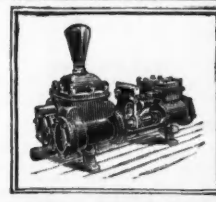
HALL DUPLEX STEAM PUMPS.

Send for 1890 Catalogue.

Fire Pump.

HALL STEAM PUMP CO.,
91 LIBERTY ST., NEW YORK.
PITTSBURGH. CHICAGO. ST. LOUIS.

Boiler and Pump Combined.



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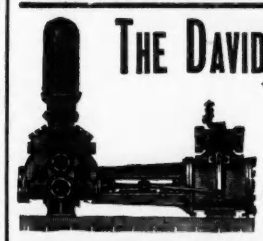
BUFFALO, N.Y. — MANUFACTURERS OF
STEAM PUMPS
FOR ALL DUTIES.



THE DAVIDSON STEAM PUMPS AND PUMPING ENGINES.
WARRANTED THE **BEST MADE** FOR ALL SITUATIONS.
Manufactured by
M. T. DAVIDSON.
PRINCIPAL OFFICE AND WORKS, 43-53 Keap St., Brooklyn, N. Y.
BRANCH OFFICES: 77 LIBERTY STREET, NEW YORK. 51 OLIVER STREET, BOSTON.

DUPLEX STEAM PUMPS. POWER PUMPS. PRESSURE PUMPS. INDEPENDENT CONDENSING APPARATUS
BARR PUMPING ENGINE CO.
GERMANTOWN JUNCTION, PHILADELPHIA, PENNA.

VALLEY PUMP CO.,
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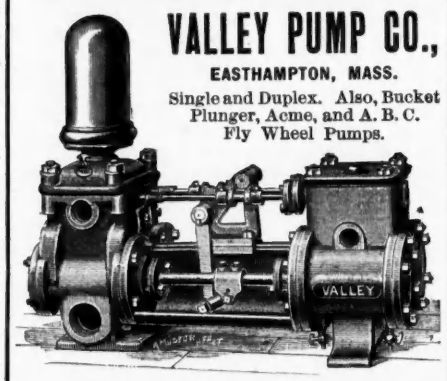

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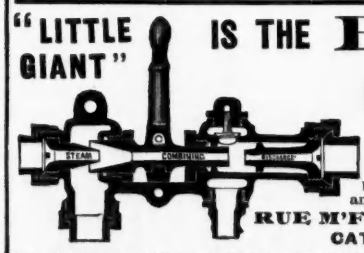

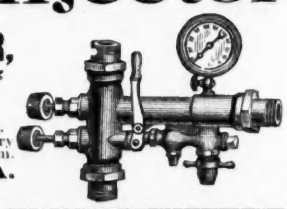

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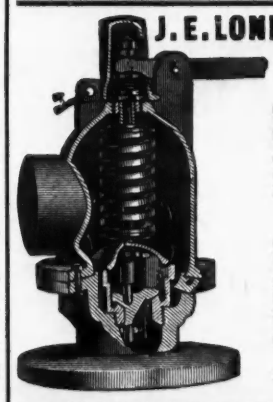

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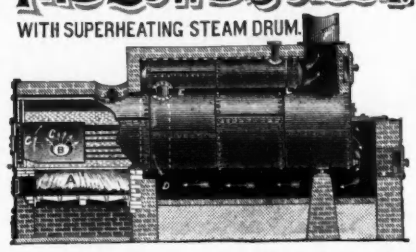

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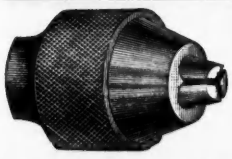

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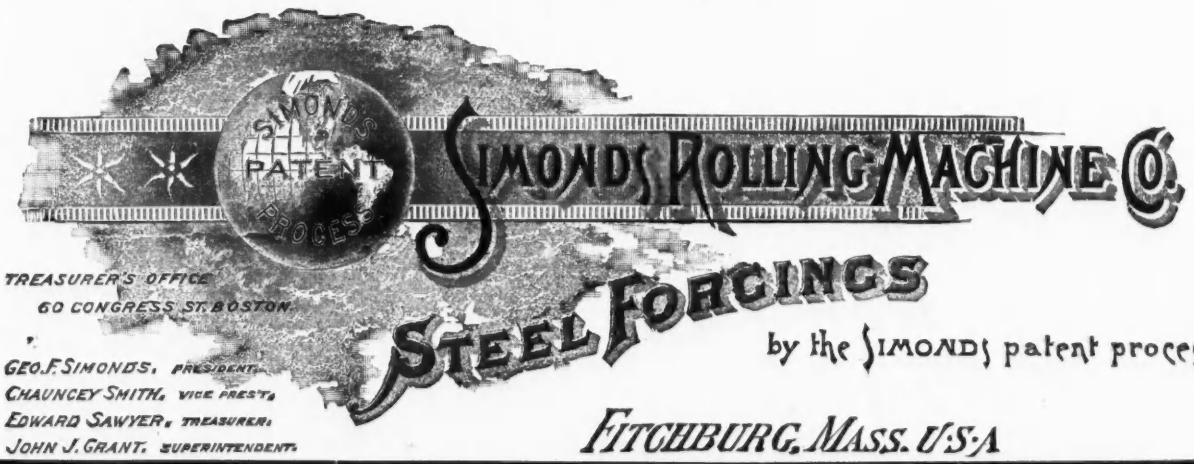

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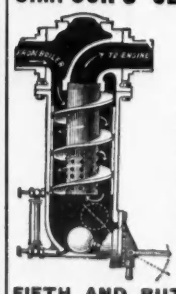

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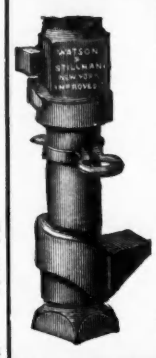

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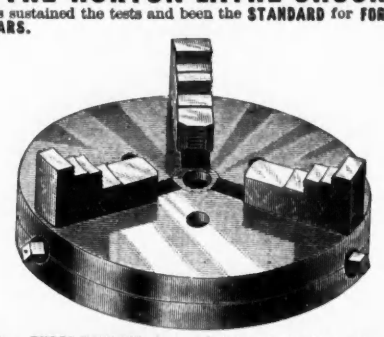

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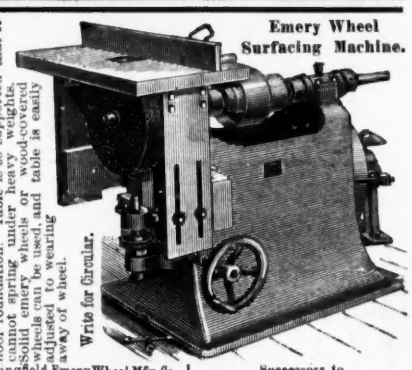

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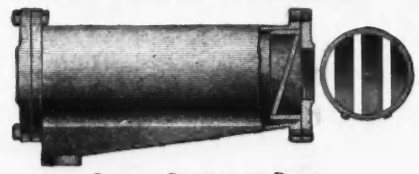

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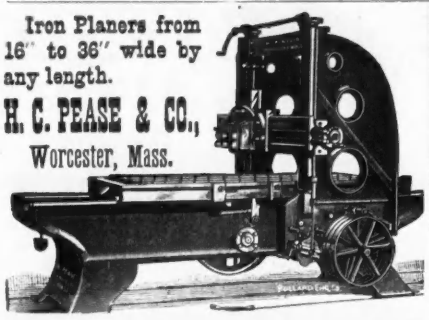

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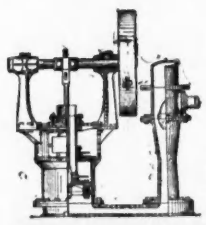

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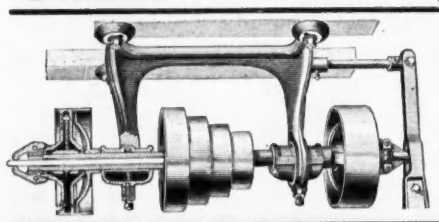

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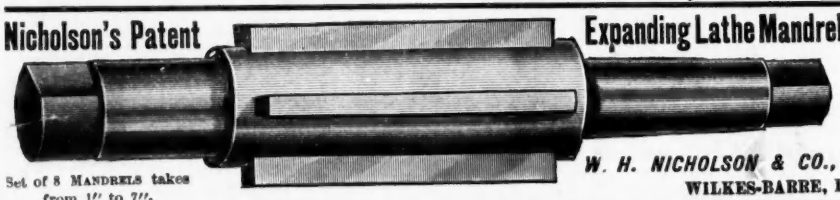

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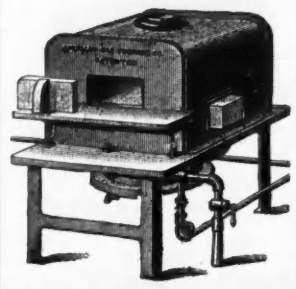

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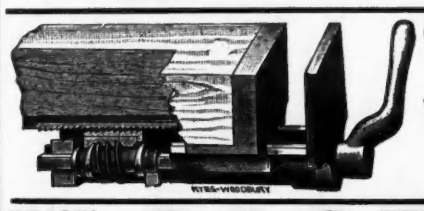

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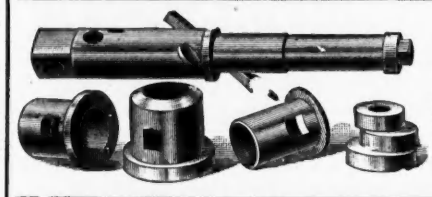

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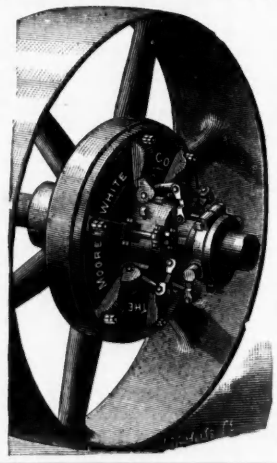

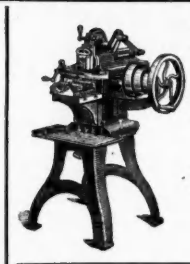

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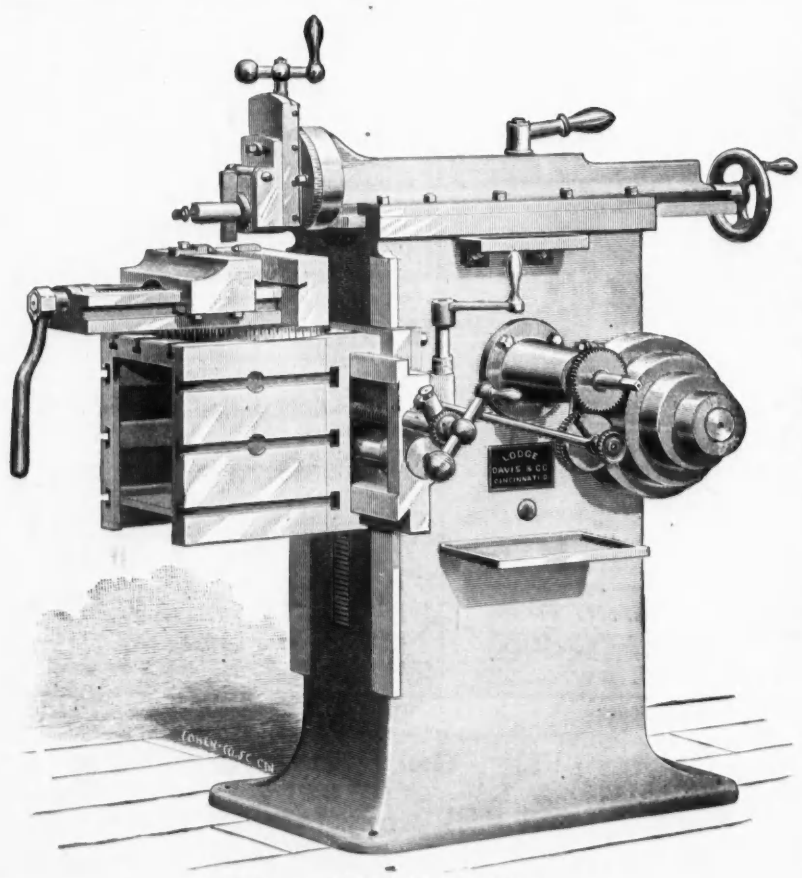

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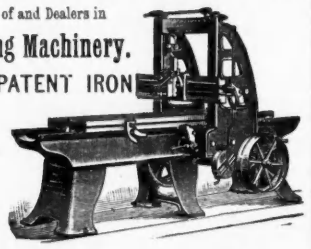

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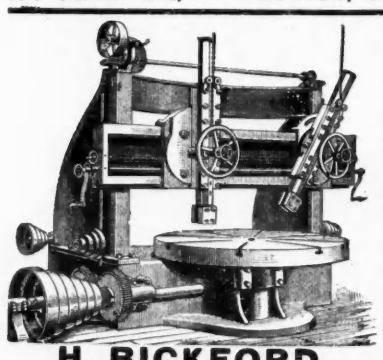

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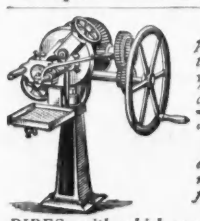

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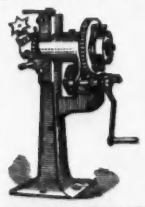

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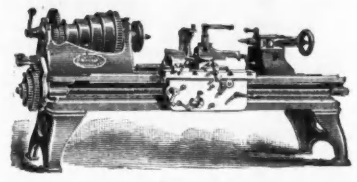

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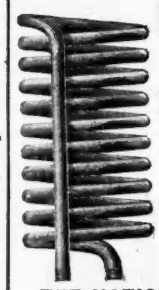

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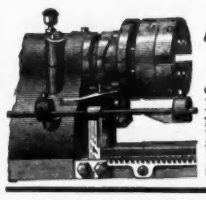

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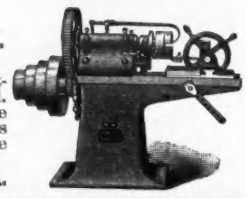

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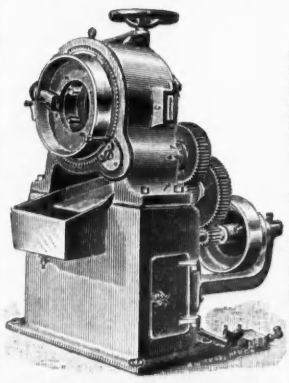

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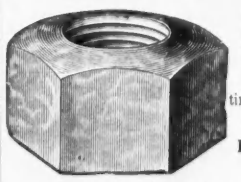

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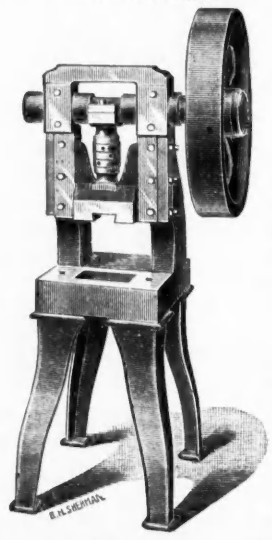

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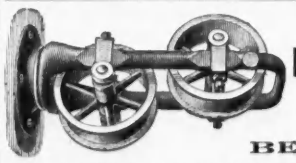

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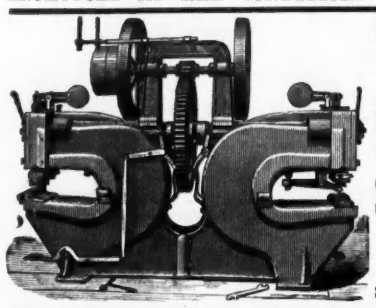

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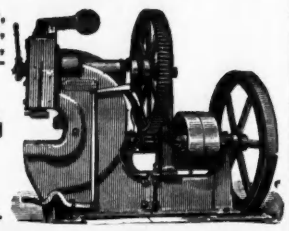

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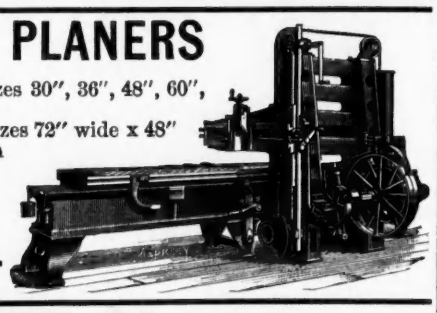

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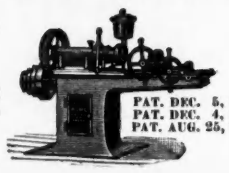

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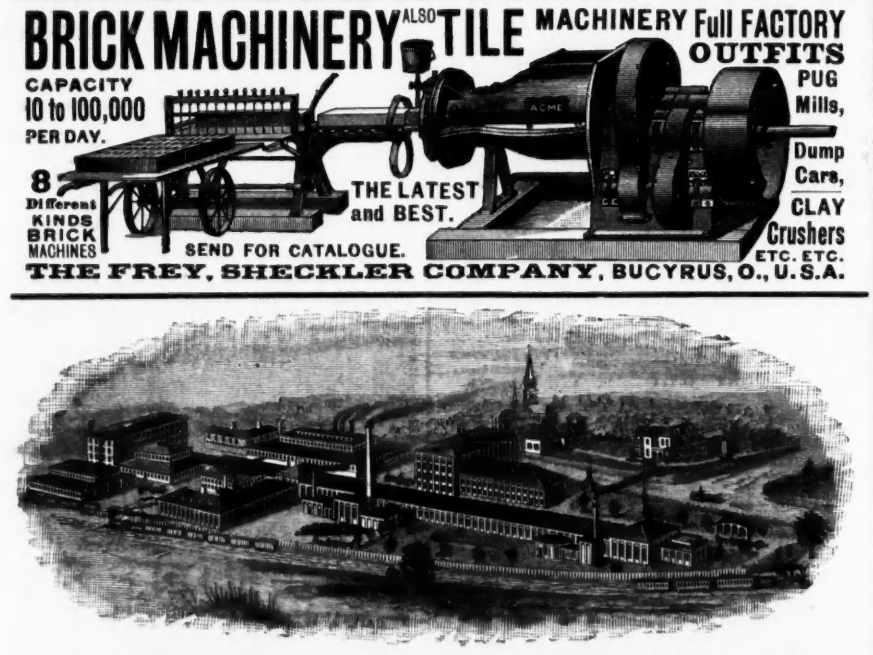

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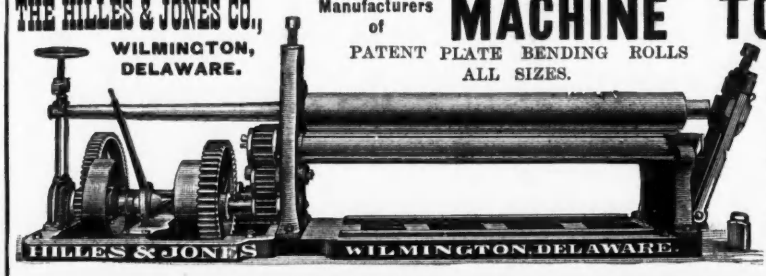

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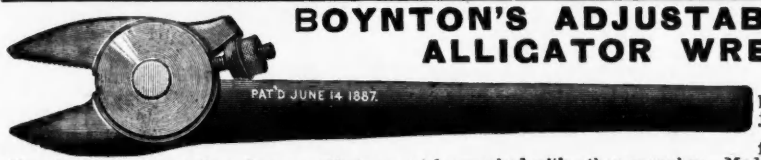

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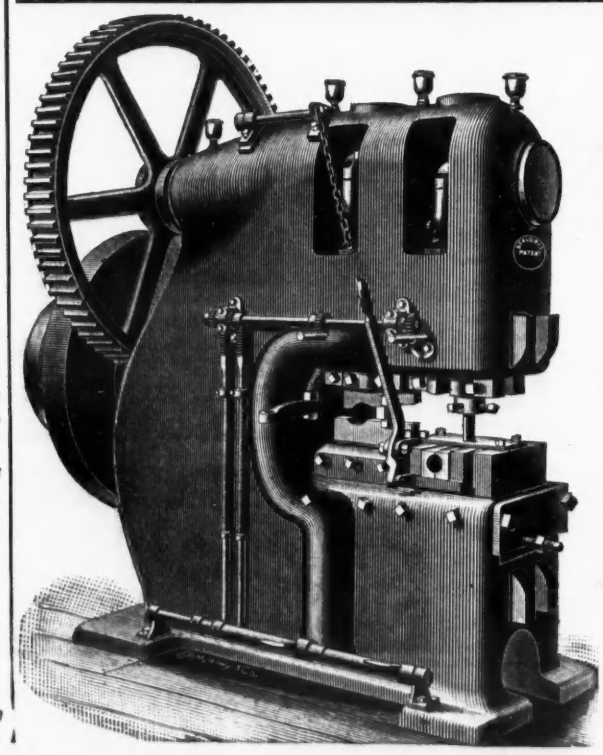

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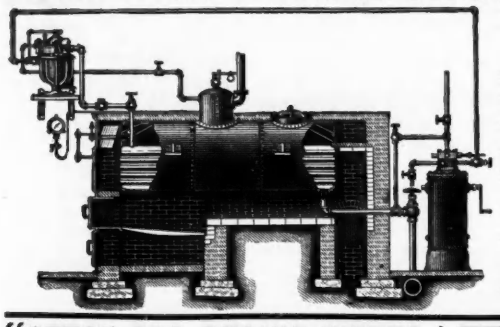

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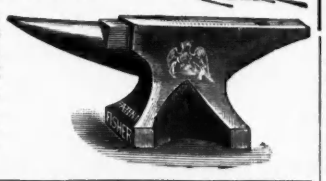

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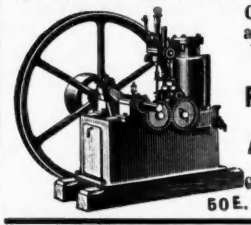

OPERATED with COAL and OTHER MANUFACTURED GASES AND GASOLINE.

RELIABLE AND ECONOMICAL.

Fully Warranted

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LANE'S Foundry & Machine WORKS, *HUNTINGDON, PA.*

Fine Upright Engines.

The following sizes are carried in stock, made in large quantities, with special tools, at special prices:

3, 4, 5, 6, 7 & 9 H. P.

If you want one Engine, it will pay you to write us. If you handle large quantities, it will pay you to write us.

PATENT UNIVERSAL DEPTH ANGLE AND SCREW-CUTTING CENTER **J. WYKE & CO., TWIST DRILL GAUGE.**

Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular.

NEW AND SECOND-HAND MACHINERY

FOR IMMEDIATE DELIVERY.

One Fifield Lathe, 30″x16′. New.
One Lathe and Morse Lathe, 32″x15′. New.
One Blaisdell Lathe, 28″, raised to swing 36″ on 12 bed. In good order. Second-hand.
One Fifield Lathe, 38″x14′. New.
One Powell Planer, 30″x30″x8′. New.
One Powell Planer, 36″x36″x12′, with 2 heads. New.
One L. W. Pond Planer, 44″x40″x12′, with 2 heads. New.
One Slotting Machine, 16″ stroke. Second-hand.
One Bement Steam Hammer, cylinder 16″x44″ rated 3500 lbs. In fine condition.
Send for Complete List of New Tools.

HILL, CLARKE & CO.,

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MACHINERY ON HAND

Engine Lathe,	14 in. x 6 ft.	Fitchburg,	new
" "	14 in. x 6 ft.	Hendey,	"
" "	14 in. x 6 ft.	Prentice,	"
" "	15 in. x 6 ft.	Porter.	"
" "	16 in. x 8 ft.	Hendey,	"
" "	16 in. x 6-8 ft.	Prentice,	"
" "	16 in. x 8 ft	McMahon,	"
" "	18 in. x 8 ft.	Prentice.	"
" "	18 in. x 8 ft.	New Haven,	fair
" "	18 in. x 10 ft.	McMahon,	new
" "	20 in. x 10-12 ft.	"	"
" "	20 in. x 10 ft.	Wright,	"
" "	20 in. x 10 ft.	Fifield,	"
" "	20 in. x 8 ft.	Wood light,	good order
" "	24 in. x 12 ft.	Wright,	new
" "	27 in. x 12 ft.	Lathe & Morse,	"
" "	28 in. x 16 ft.	Fay & Scott,	"
" "	30 in. x 16-18 ft.	Wright,	"
" "	32 in. x 16 ft.	Fay & Scott,	"
Pulley Lathes,	39 in., 2 heads.	Niles,	A-1 order
" "	26-36-50 in.	Stevens,	good order
Fox Lathes,	several sizes,	"	"
Turret Lathes,	15-20-40 in.		new
Chucking Lathes,	several sizes,		good order
Planers,	10 in. x 10 in. x 24 in.	Hendey,	"
"	16 in. x 16 in. x 5 ft.	Lathe & Morse,	new
"	22 in. x 22 in. x 5 ft.	Wheeler,	"
"	24 in. x 24 in. x 6 ft.	Lathe & Morse,	"
"	24 in. x 24 in. x 6 ft.	Fitchburg,	"
"	24 in. x 24 in. x 7 ft.	Whitcomb,	fair
"	48 in. x 45 in. x 10 ft.	Heavy pattern,	good
Shapers,	12 in. stroke,	Gould & Eberhardt,	fair
"	12 in. "	Prentiss,	new
"	14 in. " Trav. head,	Fitchburg,	"
"	17 in. "	Wright,	"
"	24 in. "	Hendey,	good order
"	26 in. "	Lodge, Davis,	new
Drills,	1 Spindle,	Garvin's,	good order
"	20 in. Comb Wheel Lever,	Prentice.	new
"	21 in. Back geared,	"	"
"	24 in. " " Self-feed,	F. S.	"
"	25 in. " " "	Blaisdell,	"
"	28 in. " " "	Currier & Snyder,	"
"	28 in. " " "	Lodge, Davis,	"
"	32 in. " " "	Prentice,	"

A Large Assortment of other Tools, New and Second Hand. Send for Complete List.

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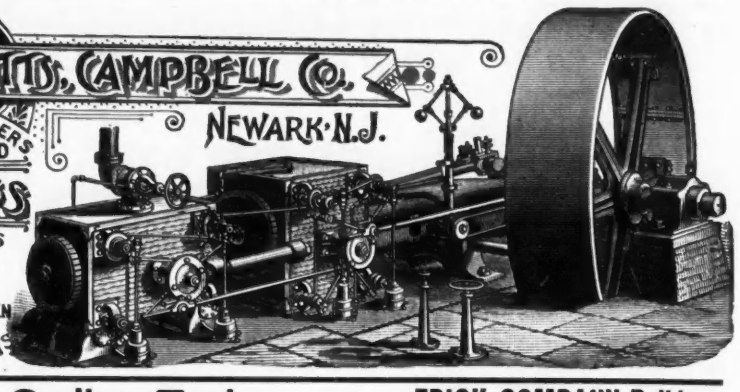

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NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

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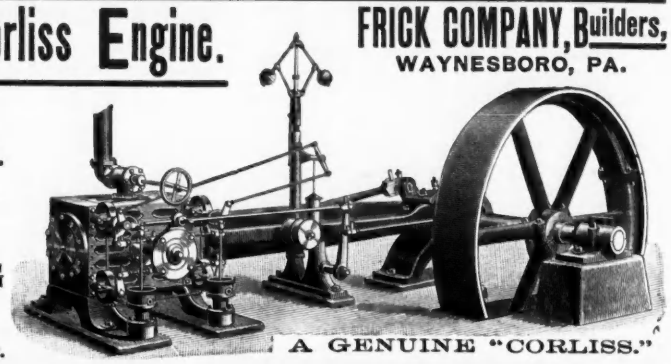

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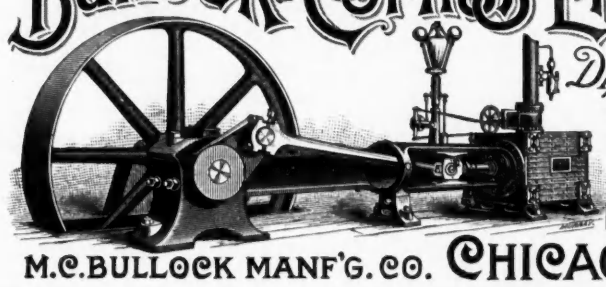
Bullock-Corliss Engines.



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MINING MACHINERY.

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Of the highest type, in all sizes, are made by

The Lane & Bodley Co.

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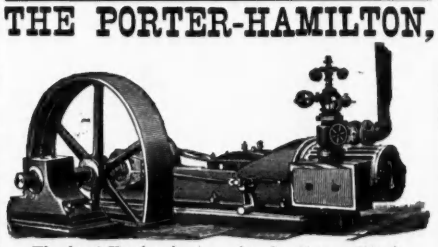

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Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

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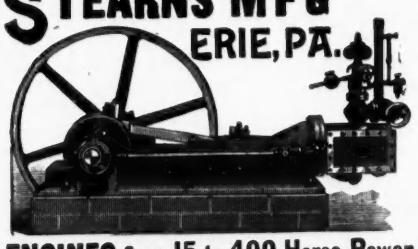

ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

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In order to close out the remainder of the stock, offer for sale

A Very Desirable Lot of Machinery,

such as lathes from 15″ to 88″ swing, planing machines 48″x45″x10′, 53″x50″x12′, 17″x14″x24′, 72″x69″x24′, and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers, and two 9″x16″ and one 10″x20″ Rider cut-off engines.

BALL AUTOMATIC CUT-OFF ENGINES,

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The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

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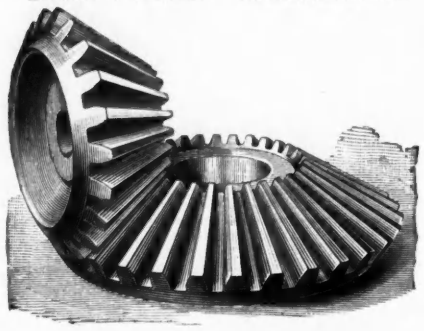

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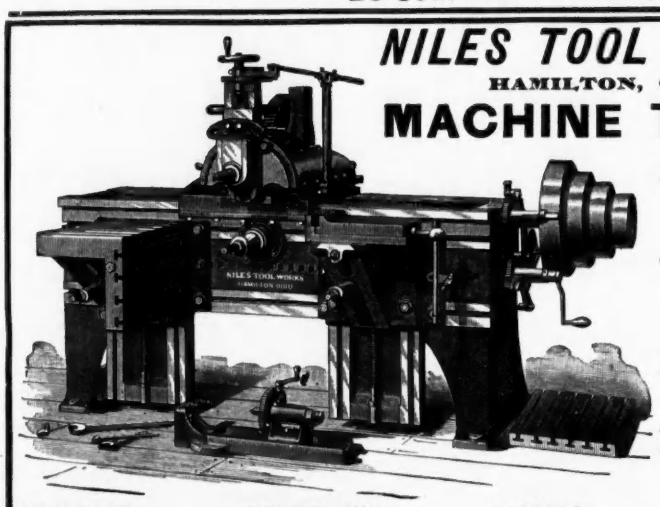

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16, 18 and 24 inch Stroke.

Extra heavy and powerful.

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Nothing but best Steam Metal used in the manufacture.
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None are genuine unless stamped with "Trade Mark."
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☞ ALL MACHINES OF OUR LATEST DESIGNS.

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AUTOMATIC GEAR CUTTER.
18 in. 25 in. 36 in. 50 in.
60 in. 84 in. Sizes.

"Experts pronounced it the best."

GEAR AND RACK CUTTING TO ORDER.

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SMALL AUTOMATIC MILLER,
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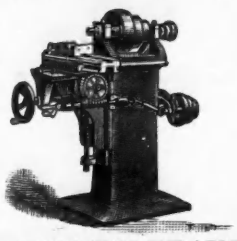

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The construction of the Caliper is such that it protects the scale from wear and abrasion. The scale is divided to 64ths on one side and the other to 100ths of an inch. The graduation is accurate and the finish of the tool is first-class in every respect. Cut represents Caliper one-half size.

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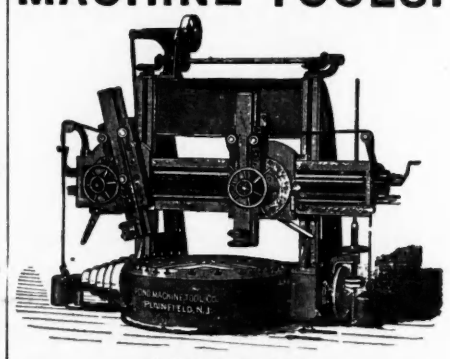

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Radial Drills, Planers, Lathes, Heavy & Powerful, from new patterns of the latest and best designs.
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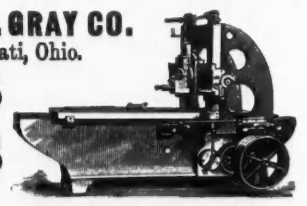

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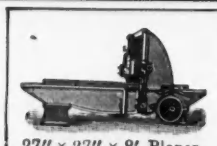
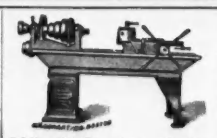
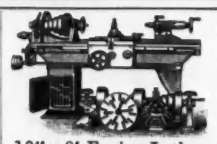


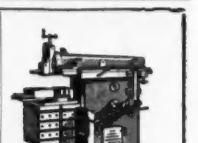
27" × 27" × 8' Planer.



20" × 6' Chucking Lathe.



16" × 6' Engine Lathe.



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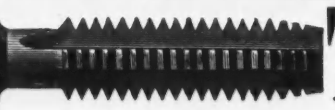

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